FEBRUARY
1959

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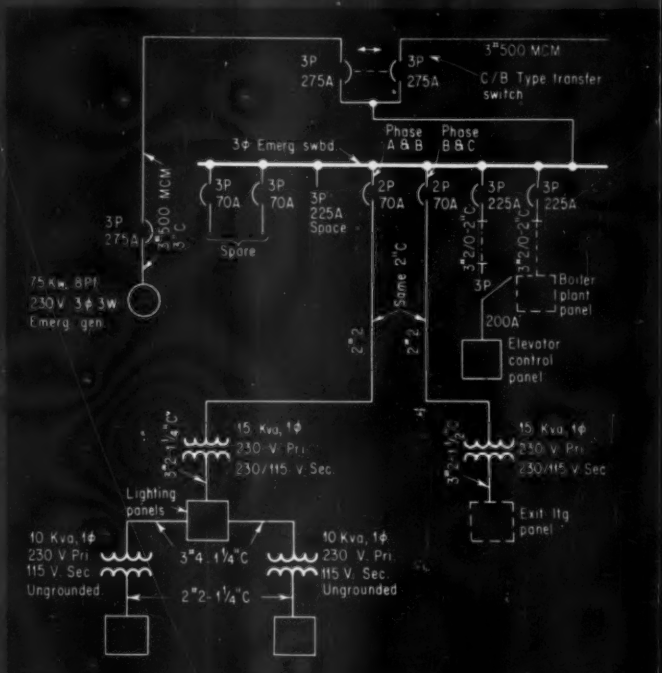
TEXTBOOK WIRING

in college laboratory uses wide variety of distribution systems as working demonstration of electrical construction methods.

STANDBY

plant assures continuity of vital power supply to a Cleveland hospital.



RELIGHTING

of New Orleans stadium employs aerial cable primary distribution system.

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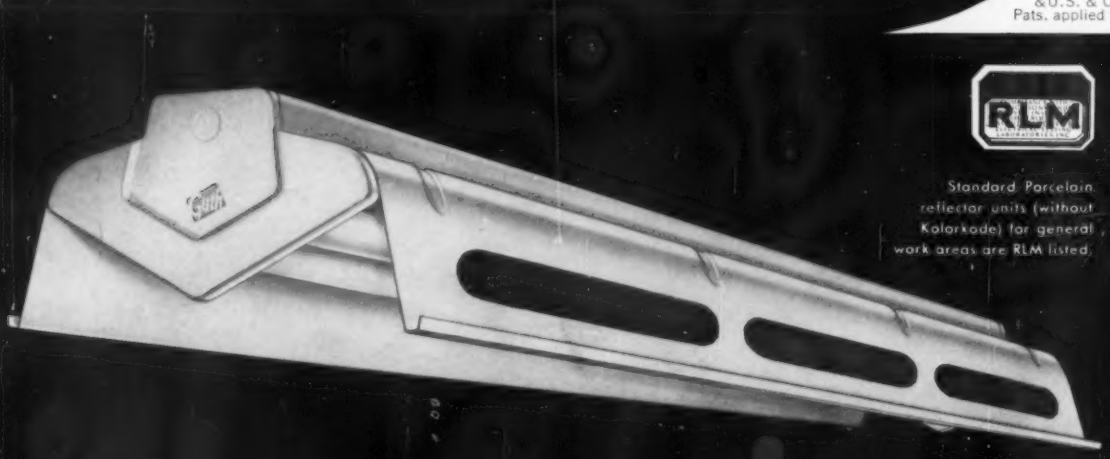

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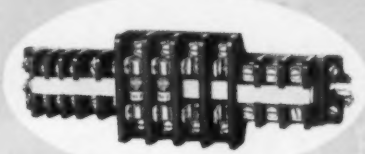

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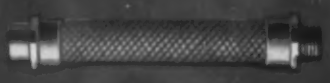

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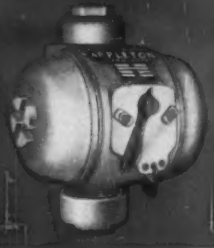

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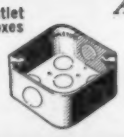

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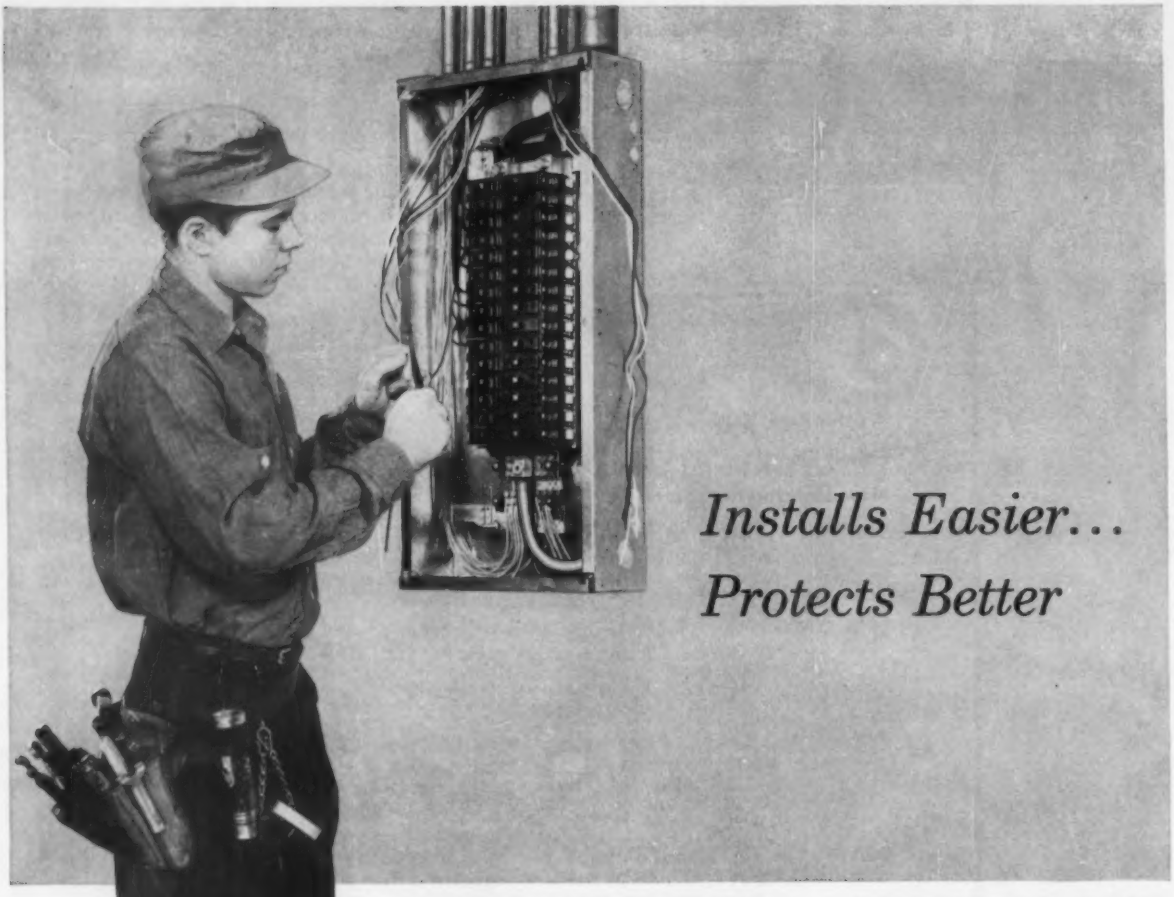
MORE



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ELECTRICAL CONSTRUCTION AND MAINTENANCE

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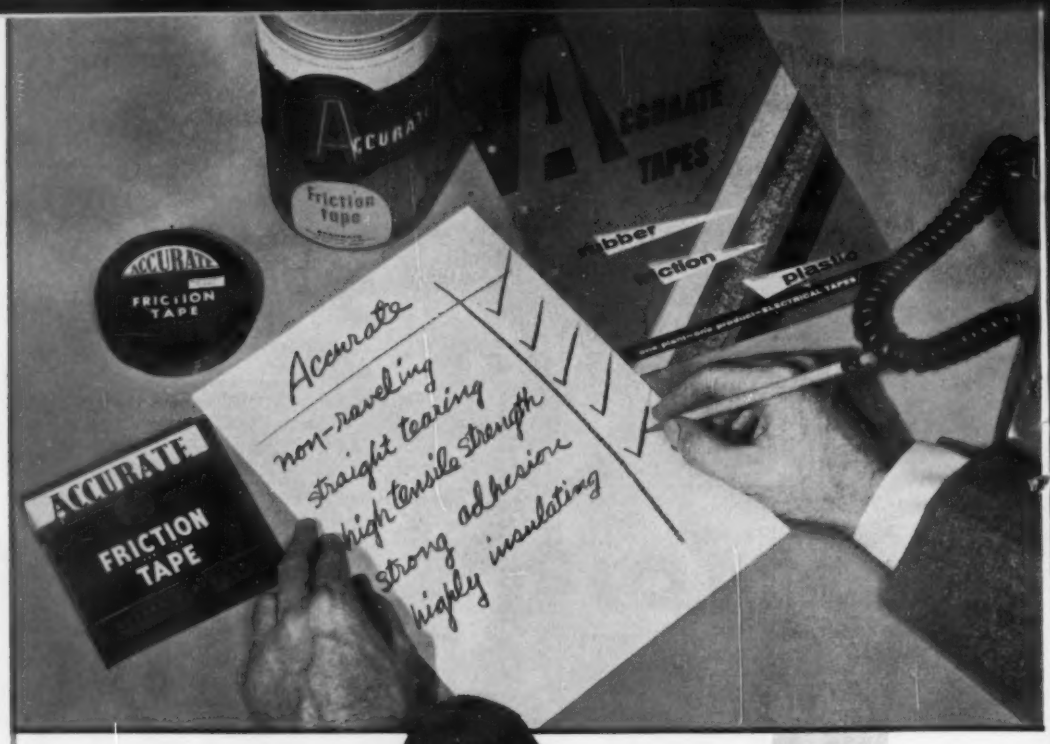

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Washington Report

FEBRUARY • 1959

Last month President Eisenhower submitted to Congress a balanced budget for fiscal 1960, with expenditures listed at $77 billion, receipts at $77.1 billion. Expenditures included: national security—$45.8 billions; veterans—$5.1 billion; agriculture—$6.0 billion; interest—$8.1 billion; all other—$12.0 billion. Estimated receipts included: individuals—$40.7 billion; corporations—$21.5 billion; excise taxes—$8.9 billion; all other —$6.0 billion. Expenditures would thus be about $3.4 billion less than the current fiscal year spending—all cut from civilian programs.

Mood of the Democratic-controlled 86th Congress is to keep Government spending at least up to the current rate. Democratic programs which will be pushed include more spending for defense, public works (housing, schools, airports, etc.), and welfare programs (more pay for unemployed, bigger social security retirement benefits, etc.).

The national economy is headed for new highs. Gross national product (GNP) averaged $437 billion in 1958 (ranging from $426 billion annual rate in 1st Q. to $453 billion in 4th Q.), is predicted to average about $463 billion for this year, with annual rate of a possible $480 billion in 4th Q. of 1959. Bolstering this Dept. of Commerce forecast are existing inventory requirements, government programs, and home-building expansion. Also, consumer incomes and purchasing are at new highs, and Federal, state and local governments continue to provide a growing market for goods and services.

Government's civilian employee payroll will reach $14.5 billion during fiscal 1960, under the President's $77 billion budget, or some $300 million over the present level. Average pay for each federal employee climbed from $2175 to $5510 between June 30, 1942 and June 30, 1958, or 153.3%. Government's civilian employees now total 2,369,000 persons.

Nearly 2.5 million persons were on the payrolls of local governments in metropolitan areas in April 1957, according to a survey made by U. S. Census Bureau at that time. Payrolls for that month totaled $837 million, Census reported. This was an estimated 62% of all local government employment, and 68% of all local government payrolls.

Census Bureau is now conducting a survey covering operations of manufacturing companies during calendar year 1958. An estimated 285,000 firms will be questionnaired, involving more than 450 different industries. This survey will update the information provided by the last regular Census of Manufactures covering the calendar year 1954, and make available new statistical data for marketing and other industry studies.

Shipments of fluorescent lamp ballasts totaled 16,234,000, valued at $43,910,000, for the first nine months of 1958, as reported by Census Bureau. Corrected power factor types totaled 9,408,000, valued at $38,546,000. Rapid start type ballasts accounted for 45% of the corrected power factor types.

Electric power consumption reached a new high last month, for week ending January 10, when output totaled 13.554 billion kwhr. This was 8.4% ahead of the year-earlier similar period.

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engineering news

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Engineering Department

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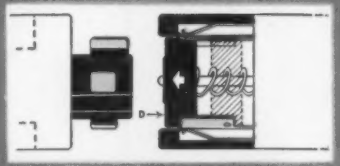
4-wire "Hubbellock" units have an A.C. rating of 30 amperes, 600 volts to meet needs of industry for higher voltages and current values. Higher voltages may mean higher frequencies, particularly for high frequency tools, welders, generators, etc. *High frequency equipment must be segregated from equipment operating on commercial power frequencies.* Here, "Hubbellock" answers a specific need because it is *completely non-interchangeable* with other types of wiring devices.

ROUGH SERVICE CONDITIONS

"Hubbellock", with its heavy steel outer casing, is the logical choice for applications where devices are subjected to unusually rough service. All the electrical wiring is completely enclosed within a protective steel shell capable of withstanding severe abuse or a lifetime of heavy duty service. The "Hubbellock" dead front prevents entrance of dust, lint, metal filings, dirt, etc. The contacts are completely enclosed and protected from foreign elements. "Hubbellock" can, in fact, be recommended for many applications that require mandatory use of sealed power units.



Safety shutter (D) is backed up by a heavy coiled spring which pressures the shutter out against the face of the recep-

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Sidelights

POSTSCRIPT TO SCHOOL SAFETY

Our editorial in the January issue, "Toward Safety in Schools", advocated the prompt installation of automatic fire detection and warning systems in schools referring to the recent school fire disaster in Chicago. Since the editorial was written, both the coroner's jury report and a report by the National Fire Protection Association (NFPA) have made extensive recommendations based upon investigation of Chicago's disaster. Both reports recommended the installation of automatic fire detection and warning systems.

DEMONSTRATION WIRING

In planning the laboratory facilities for a new 7-floor building for the Stevens Institute of Technology in Hoboken, N. J., the electrical work was varied to include many different types of equipment and wiring methods as a practical demonstration of modern electrical system facilities and techniques for study by undergraduate engineers. The installation is described by Albert A. Richman, president of Lightning Electric Service Co. of Newark, electrical contractors for the project in "Textbook Distribution" beginning on page 63.

FLOODLIGHTING CIRCUITS

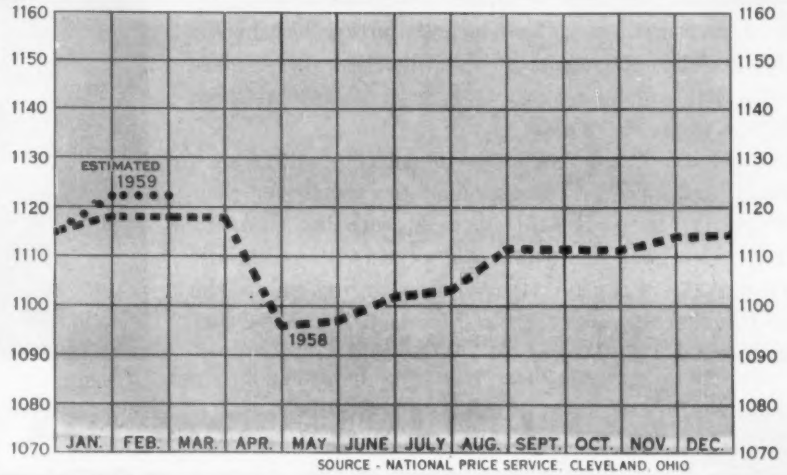
Electrical design of distribution and branch circuiting for outdoor floodlighting has recently been undergoing a sort of revolution. The development of new lamp types and luminaires has combined with the rapidly expanding shift to high-voltage feeder circuits to require much more analysis by the electrical designer. When efficiency and economy are related to selection of an electrical system for a given set of physical factors and lighting requirements, a considerable chore is involved. But B. Z. Segall, consulting engineer, measured up to just such a job in the relighting of City Park Stadium in New Orleans, La. And this job was complicated by the requirements of electrical modernization. The details on the job, with its primary CB and aerial-cable feeder, are given in the story beginning on page 76.

HOSPITAL STANDBY POWER

In the expansion and modernization of Polyclinic Hospital in Cleveland, Ohio, a disaster power supply system was carefully planned and coordinated with the normal electrical system to provide instant transfer of essential loads to a 60 kw diesel powered generator in the event of a failure in both of the two normal services. The transfer to emergency power supply, engine start-up and return to normal supply are handled by an automatic transfer switch. The installation is described in "Standby Power Supply" beginning on page 90.

ELECTRICAL MATERIALS COST INDEX

BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.



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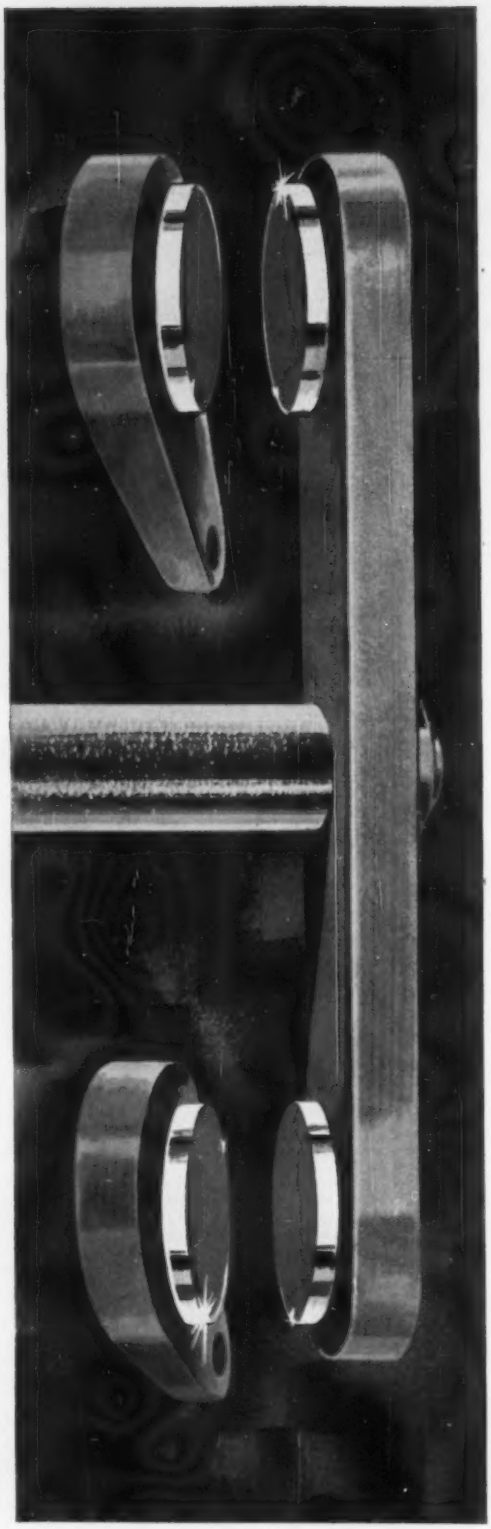

Household safety switches may look alike, and may be priced alike. But you're smart to buy the C-H 4151 Midget Safety Switch because it has *extra* qualities, gives *extra* performance, helps you do the kind of job that gets more jobs.

ONLY the C-H 4151 has solid silver double-break, butt-type, vertical contacts. Silver, long standard in industrial control, far outlasts contacts of copper or bronze. The double-break contacts cut arc voltage in half, further lengthening contact life. There's no scrape or slide when these face-to-face butt-type contacts close . . And vertical construction sheds dust, keeps the contacts clean.

Yes, this combination of extras make this switch work faultlessly, indefinitely. There's no better switch for your customers, yet the C-H 4151 is priced with the cheapest. Why accept less? See your nearby Authorized Cutler-Hammer Distributor. Or write for the handy ordering guide, the *Cutler-Hammer Merchandiser*, publication EA100—C-241, Cutler-Hammer Inc., Milwaukee 1, Wisconsin.

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In financial aid to education . . .

What Should Business Do Now?

Now that the federal government is entering the field, should business firms stop giving financial aid to our colleges and universities?

This question is now being discussed by business directors throughout the country. The discussion is prompted by the near-billion-dollar program of federal aid to education passed by Congress a few months ago. For if the federal government, with its access to billions in taxes, is assuming responsibility for the financial welfare of education, should not business get out of the way and let the government take over? This is the general way the question is being asked.

The answer is a resounding NO.

What The Federal Program Does

The new federal program makes it possible for the government to spend the imposing total of $900 million for aid to education over the next four years. There are still many loose ends in the program. But already it's quite clear what such funds will — and will not — do to help relieve the financial plight of our colleges and universities.

First of all, the program is not going to solve any financial problems in education overnight. The program is just barely underway. So far no money has actually been allocated, and Congress has appropriated only $40 million — less than 5% of the total.

More important, there is very little in the total program which will result in direct aid to colleges and universities. The program does set up fellowships to train college teachers. But most of the aid will eventually be channeled through the states to primary and secondary schools. The main focus of the program is education for national defense — strengthening science, mathematics and foreign languages in elementary and secondary schools, together with grants for counseling, testing and research.

The one big item for higher education is a $295 million student loan program, which will help needy students pay tuition and other fees. But tuition rarely covers the full cost to the college of educating a student. So the net result could well be an additional financial strain on our institutions of higher learning.

For the three most pressing financial needs — faculty salaries, scholarship grants and new plant and equipment—colleges and universities must still rely heavily on help from the business community. And it would indeed be a major

misfortune if the recent actions of the government put a blight on this growing and substantial support to higher education.

In the last ten years, business has expanded its financial aid to education by more than four fold. In 1948, contributions were only $24 million. In 1957, such aid reached an estimated $125 million. Moreover, corporations have been putting a larger proportion of their total charitable gifts into education. In 1950, the percentage was only 17%. By pre-Sputnik 1956, the share had already increased to 34%, according to figures recently released by the Council for Financial Aid to Education.

Why Business Must Help

The most compelling reason for increasing business aid to higher education — at an even faster rate—is that our colleges and universities desperately need financial help. It is that simple. Private contributions to higher education must average at least $400 million over the next ten years if our colleges are to meet rising operating costs and raise faculty salaries to decent levels. Despite the growth in business contributions, we are still well below that goal.

If our colleges cannot solve their mounting financial difficulties through voluntary help from business firms, alumni and communities — then it is to be expected that federal aid ultimately will be mobilized in a big way. In principle, if not in dollars, the 85th Congress has paved the way. Indeed, a large federal scholarship program was squeezed out of this year's legislation only in the course of last-minute compromises. And Arthur S. Flemming, Secretary of Health, Education and Welfare, has urged that the next session of Congress restore the scholarship program.

About any federal rescue operation for higher education, two things are quite clear:

(1) **Such aid will come too late to prevent irreparable harm resulting from the current shortage of funds.** The need for help is urgent and immediate.

(2) **With federal taxes taking over half of all corporate income, any federal program in the end will be financed in large part by the business community.**

An Opportunity

So, viewed narrowly, it is in the selfish interest of business firms to aid our colleges and universities now, rather than wait and be forced to pay later on. By doing so, they ensure that business will have a continuing supply of well-trained graduates. They take advantage of the tax laws for charitable contributions which mean the government in effect assumes more than half the cost of business aid to education. And they win gratitude for a voluntary and generous act.

Viewed in the broad public interest, the business community has an opportunity to perform a financial rescue mission in education which could well be the key to successful survival, not only of our present system of higher education, but also of the nation itself.

As previous editorials in this series have pointed out, a very small share of the net income of business firms — about 1% — would do the job. Certainly business must not be distracted from this opportunity by the new venture of the federal government in financial aid to education.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nation-wide developments. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

Donald C. McGraw

PRESIDENT

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Trouble calls eat up your profits. But not when you install Pushmatic®—the circuit breaker that prevents overheating and subsequent nuisance tripping. You save costly call-backs and the difference goes right into your pocket. The reason?

Unlike plug-in type breakers, a Pushmatic *bolts* to a bus bar, cannot work loose and cause excessive heating. It provides a high-pressure, low-resistant, *positive* contact always.

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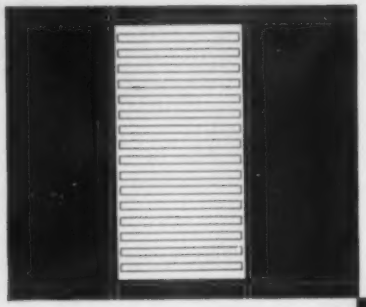
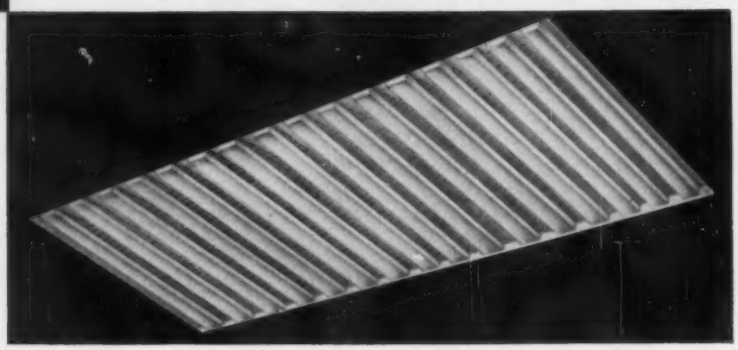
BULLDOG

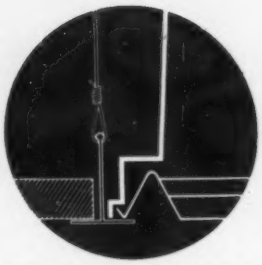
BullDog Electric Products Company, Division of I-T-E Circuit Breaker Company, Detroit 32, Mich. *BullDog Export Division:* 13 East 40th St., New York 16, N.Y. *In Canada:* BullDog Electric Products Co. (Canada) Ltd., 80 Clayson Rd., Toronto 15, Ont.



nothing but pure light!



There are good reasons why so many lighting specs hold firm for Lightolier recessed troffers: ARCHITECTS like the clean panel of light...no bulky frames or exposed screws...the neat joints and hidden hinges...the Optiplex, Domex and Strialux diffusers that meet nearly any requirement. OWNERS like the easier cleaning...no frames to handle, no broken diffusers...the finished appearance...the efficient, dependable performance. CONTRACTORS like the way one man uses detachable grab handles to lift fixtures easily...the rugged construction, trouble-free installation...the sound profits. Doesn't it make good sense to recommend and install commercial lighting by Lightolier? For a 120-PAGE CATALOG-BINDER detailing the complete architectural collection, write today to Dept. EC-29.



EXPOSED GRID CEILING DETAIL

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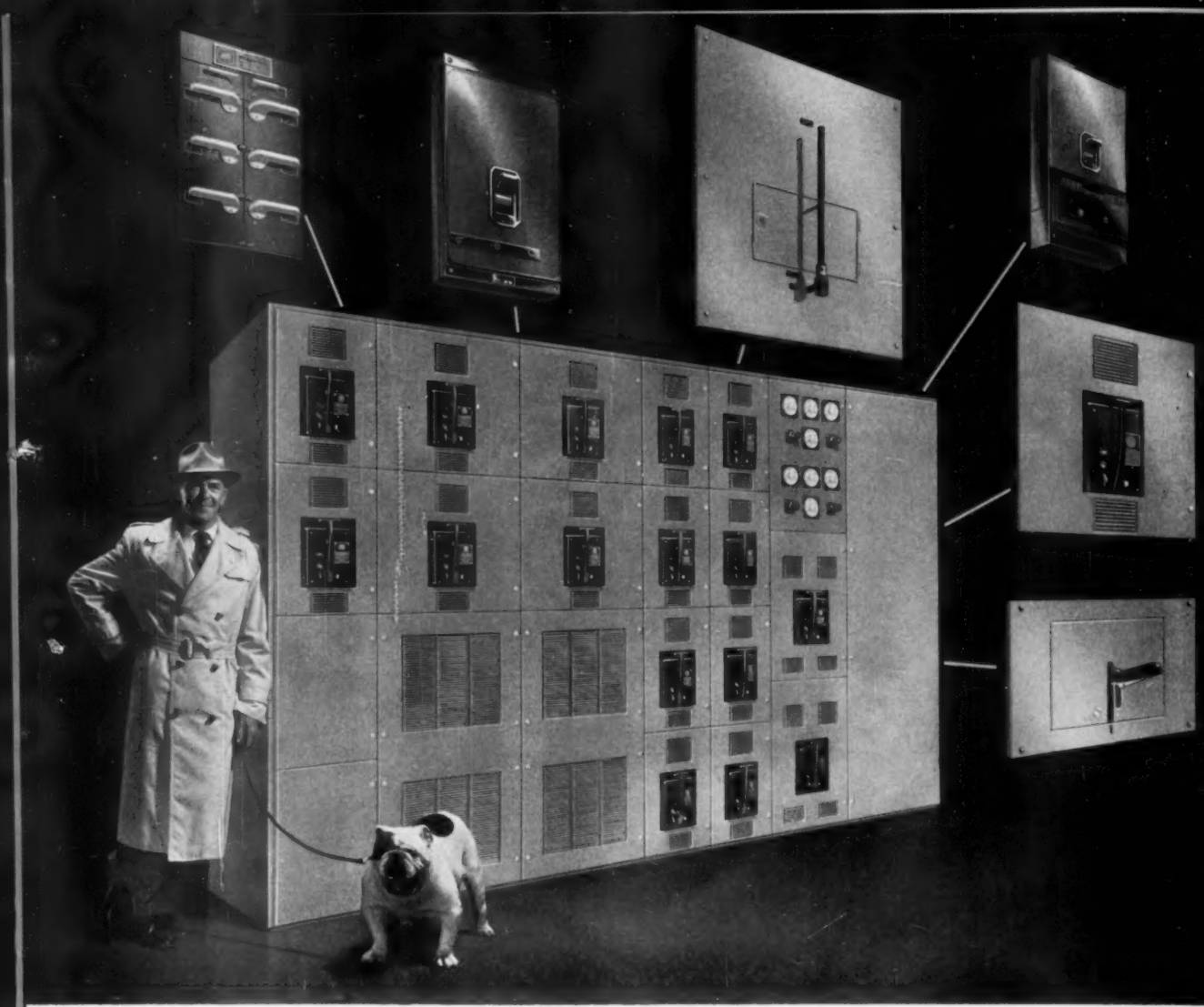

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BullDog's new Power Master lets you put everything from large air circuit breakers to small Vacu-Break® units in one space-saving enclosure. It will handle any of the following light-duty or heavy-duty switch units . . . in any combination:

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In addition there is room for current-transformer equipment and metering systems.

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BullDog Electric Products Company, Division of I-T-E Circuit Breaker Company, Detroit 32, Mich. *BullDog Export Division:* 13 East 40th St., New York 16, N.Y. *In Canada:* BullDog Electric Products Co. (Canada) Ltd., 80 Clayson Rd., Toronto 15, Ont.

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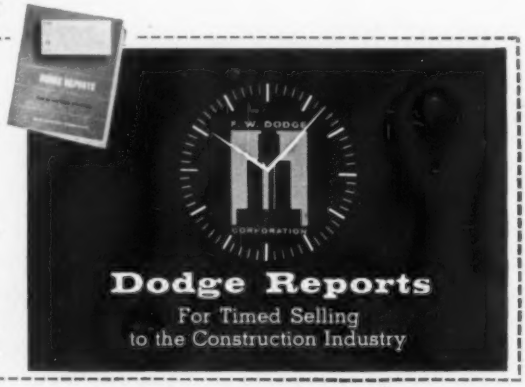

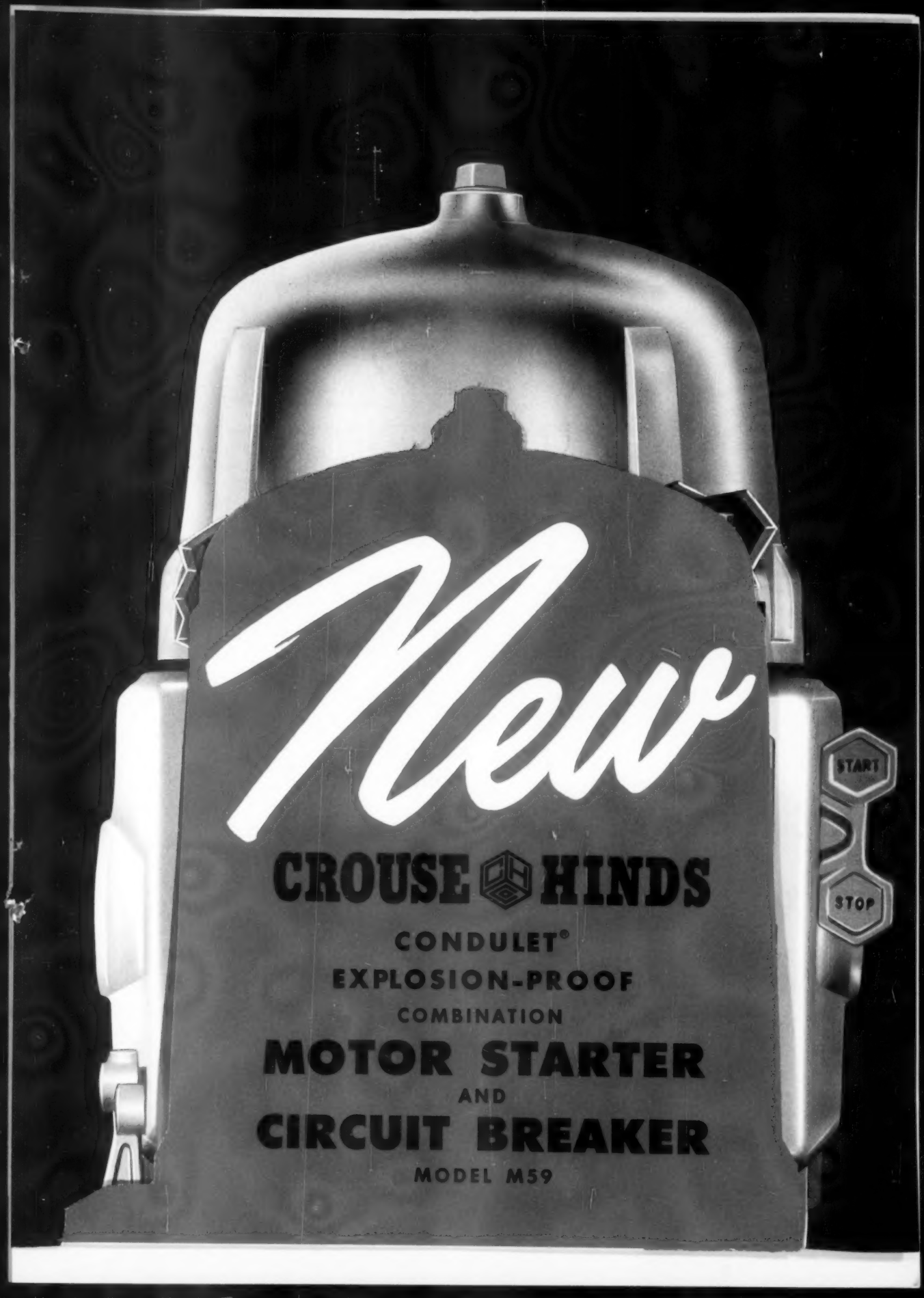
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COMBINATION
MOTOR STARTER
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MODEL M59
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NEW Rain-shedding Joints for both top and bottom covers
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HAND
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HAND
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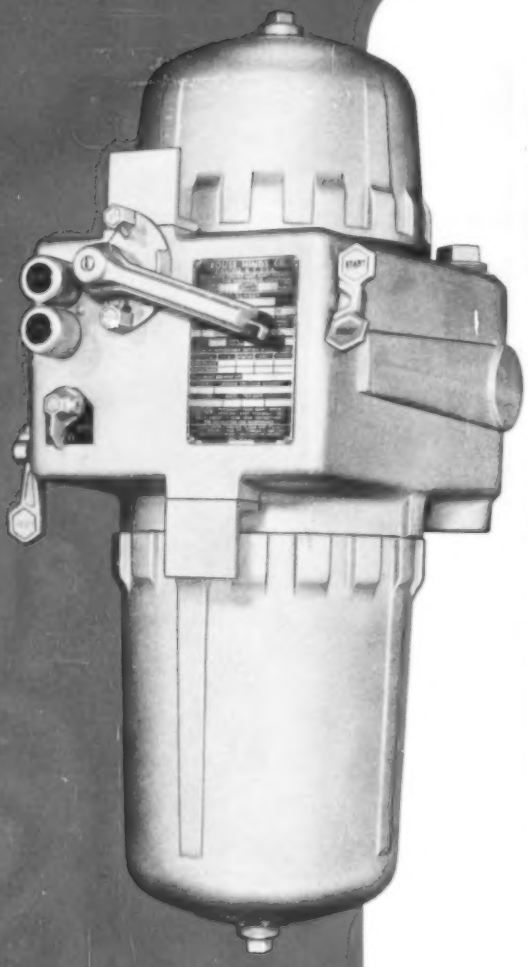
Built-in Selector Switch available
RESET
NEW Center Section (and covers) are lightweight aluminum
NEW Increased Internal Wiring Room
OTHER FEATURES ON BACK →

New Crouse-Hinds M59 Explosion-Proof Motor Starter and Circuit Breaker

gives you important extras at no increase in price

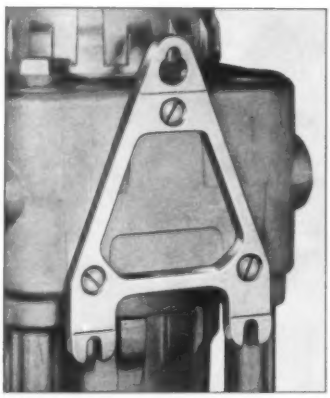


National Electrical Code: Class I, Groups C and D; Class II, Groups E, F, and G, Class III.

The M59 is now available in 7" (takes size 0 and 1 starters or combinations) and 9" (takes size 2 starters or combinations) sizes. 11" (for sizes 3 and 4 starters or combinations) size to follow.

Easy to Start Covers

New, notched covers loosen quickly with pinch bar or screwdriver.



Easy to Install

Three-hole bracket makes mounting fast and easy. Bracket is replaceable.

Other features include . . .

- Built-in breathers and drains available
- Seven taper-tapped conduit entrances
- Starter located below breaker for safe and easy maintenance
- Compact design permits greater number of motor controls in any given area

For more information, consult your Condulet Catalog, or see a Crouse-Hinds Distributor. Additional help is available from any of the Crouse-Hinds offices listed below.

CROUSE HINDS

MAIN OFFICE AND FACTORY: SYRACUSE, NEW YORK

Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.
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● CONDULET® ELECTRICAL EQUIPMENT (Explosion-Proof and Conventional) ● FLOODLIGHTING
● TRAFFIC CONTROL SYSTEMS ● AIRPORT LIGHTING and WEATHER MEASURING EQUIPMENT

These products are sold exclusively through electrical distributors. For application engineering help, contact one of the following offices: Atlanta Baton Rouge Birmingham Boston Buffalo Charlotte Chicago Cincinnati Cleveland Corpus Christi Dallas Denver Detroit Houston Indianapolis Kansas City Los Angeles Milwaukee New Orleans New York Omaha Philadelphia Pittsburgh Portland, Ore. St. Louis St. Paul Salt Lake City San Francisco Seattle Tulsa Washington
Resident Representatives: Albany Baltimore Reading, Pa. Richmond, Va.

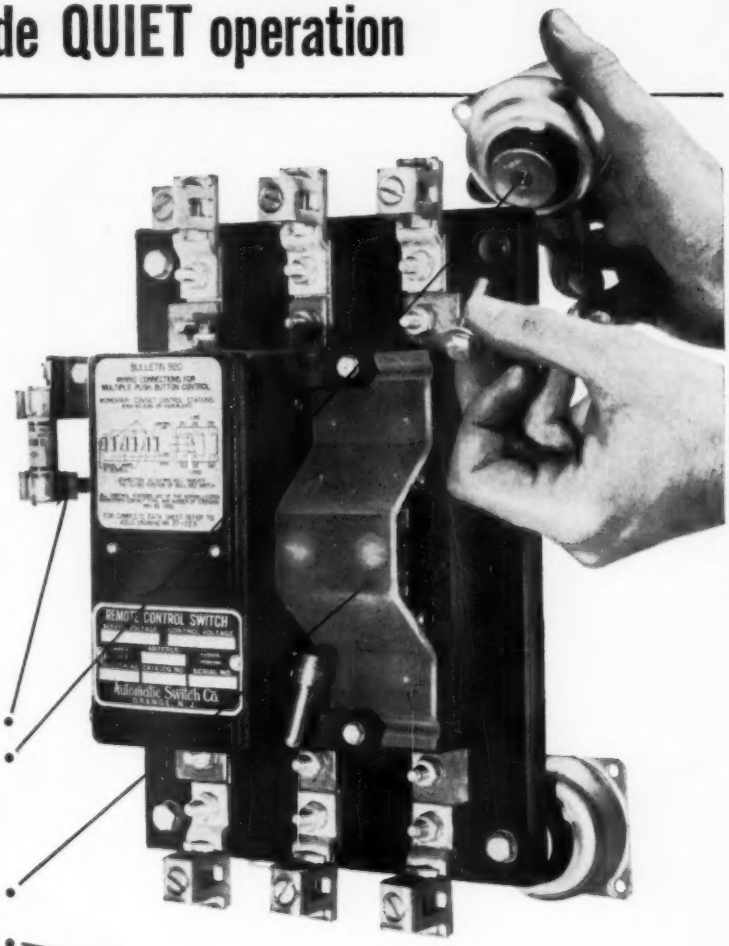
ASCO Remote Control Switches with vibration mounts and soundproof enclosures provide QUIET operation

ASCO Mechanically Held Remote Control Switches have always been inherently quiet in open or closed position. The coil is energized only during the instant of operation; accordingly, the Switch is free from distracting A-C hum.

Now, through ASCO accessories, shock noises produced during opening and closing can be drastically reduced.

Shock and Vibration Isolators are easy to install—reduce operating noise normally audible from 250 ft. away to unobjectionable levels at 35 ft.

Soundproof Enclosures, when added to the shock and vibration isolators, reduce the sound of switch operation to a click faintly audible from a distance of only 3 feet.



COMPLETE ACCESSORIES

Rugged, simple Bulletin 920 Remote Control Switches are available with:

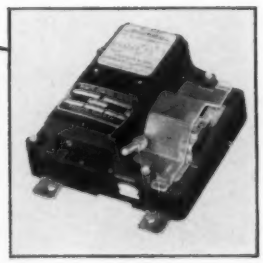
Adapter—for control line fuse.

Shock and Vibration Isolator Mounts — provide efficient shock absorption, substantially reduce switch operating noise. Mounts are easily installed or removed —a single bolt holds each one to the panel.

Cover Plate — permits manual operation with complete protection from contacts.

Reduced Width Dimensions — for installations where space is at a premium. Reduced width 920 RC is only 5⅞" wide!

Soundproof Enclosure — with bonded acoustical insulation. Since ASCO switches are designed to operate in unventilated enclosures, derating is never necessary.



ASCO Bulletin 920 Switches equipped with low voltage control are suitable for 24-volt A-C control by push button, time switches, relays or other control methods—installation costs go down, safety and permissible line runs are increased.

For complete data on ASCO Remote Control Switches and accessories, write for Catalog 57-S2.

Automatic Switch Co.

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AUTOMATIC TRANSFER SWITCHES • SOLENOID VALVES • ELECTROMAGNETIC CONTROL

ASCO®

Specify McGILL® *Levolier*® switches

...for guaranteed precision plus durability

The high standards of design, craftsmanship and material selection make it possible to guarantee No. 41 LEVOLIER switch unconditionally against failure in lighting circuits. This extra quality is reflected in the performance of all LEVOLIER switches.

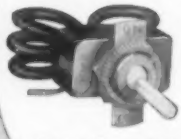
It pays to specify the best to avoid frequent and costly replacement. LEVOLIER canopy, toggle, push button and momentary contact switches easily withstand the hard use and abuse of industrial service. All are Underwriters' Laboratories inspected.

UNCONDITIONALLY GUARANTEED No. 41 single-pole, single-circuit, universal lever switch 6 amp. "T" 125V—3 amp. 250V. Only 5/8" thick, it is ideal for conduit box and canopy mounting for lighting and FHP motor control.

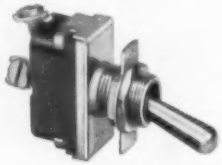
No. 100 single-pole, 15 amp. 125-250V, 1 HP 120-240V AC, normally "OFF" momentary contact switch. 1 amp., 125V—1/2 amp., 250V DC. Especially suitable for limit and safety control of industrial machinery.

No. 29 single-circuit, .75 amp., 125V, normally "ON" momentary contact switch. Excellent for automatic control of lights as in door openings and closings.

No. 71 single-pole, single circuit, universal lever switch . . . the thinnest 6 amp. "T" 125V—3 amp. 250V switch of its kind on the market today — only 15/32" thick. Also with push button.



No. 25 toggle switch carries a 6 amp. "T" 125V, 3 amp., 250V rating with an S.P.S.T. double-break mechanism. 1/3 HP AC 120-240V. Ideal for panel board, FHP motors, appliances, power tools, etc.



No. 90 3/4 HP capacity, 15 amp. 125V, 10 amp. 250V toggle switch with an S.P.S.T. mechanism. Designed for AC operation. Also carries 20 amp. 125V AC non-inductive load for heater applications. Also available in two circuit with center off and no off. Choice of terminals.

For complete descriptions of the entire McGILL line of switches, sockets, portable lampguards and other electrical specialties, write for catalog No. 84.

AVAILABLE FROM YOUR ELECTRICAL WHOLESALER

engineered electrical products

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precision needle roller bearings

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there's waste and extra work in trying to tear plastic tape . . .
but not when you use the exclusive new SLIPKNOT Cutter, packed free*
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Try it today.

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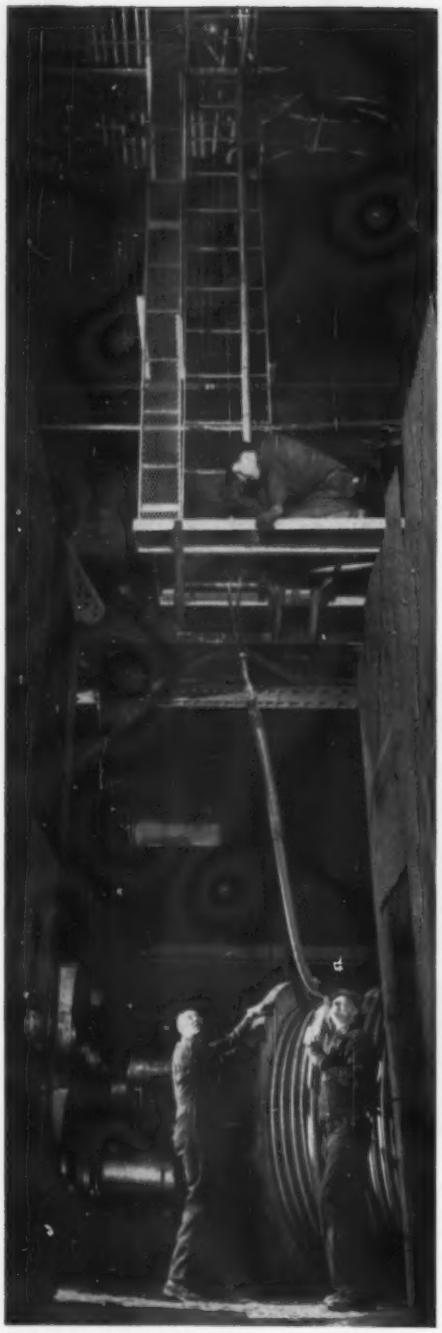
If you want to be sure install Tiger Brand



Cable is pulled through the racks. Pulleys ease it through at each turn.

SINCE we've been making electrical cable at American Steel & Wire since 1891, customers often ask us how they can best plan for *future* wiring needs. They've seen the shocking cost of plant modernization programs in buildings that were not designed with foresight.

Electrically speaking, you're going to need a *flexible* wiring system, one that can be enlarged or revamped with ease. To lots of designers today, that means a feeder system that is *not* permanently sealed in rigid conduit, frequently buried under tons of concrete and, in case of damage, frequently unrepairable. All of these problems are solved when you install flexible Armorlokt in an open-rack system.

Initial installation is not difficult. Extra feeders can be added easily at any time. Special feature: Splices can be made *anywhere* along the cable's length. The pictures on these pages show how adaptable and flexible such a wiring system can be.

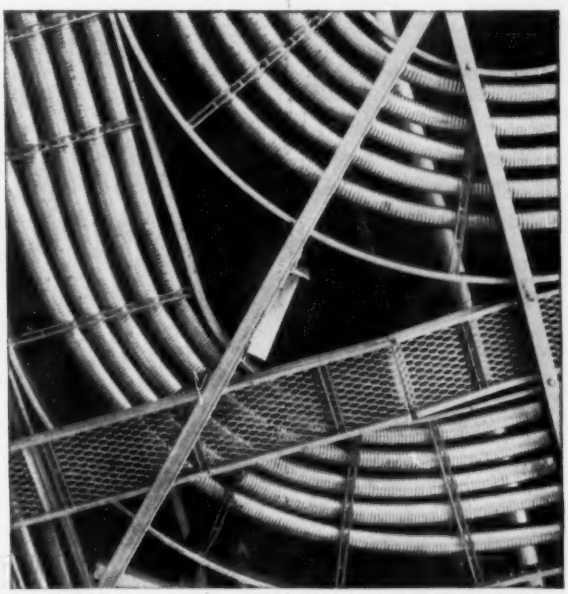
Tiger Brand Armorlokt is made in a complete range of sizes and constructions. Ask your AS&W salesman. American Steel & Wire. Gen'l Offices: 614 Superior Ave., N.W., Cleveland 13, O.

USS American Steel & Wire Division of United States Steel

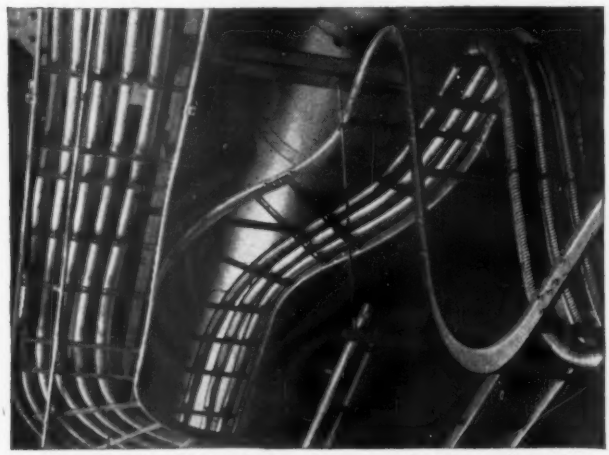
Winch on truck does the pulling. Crew members talk to each other with telephones.

# of adequate wiring in 1979, Armorlokt now!

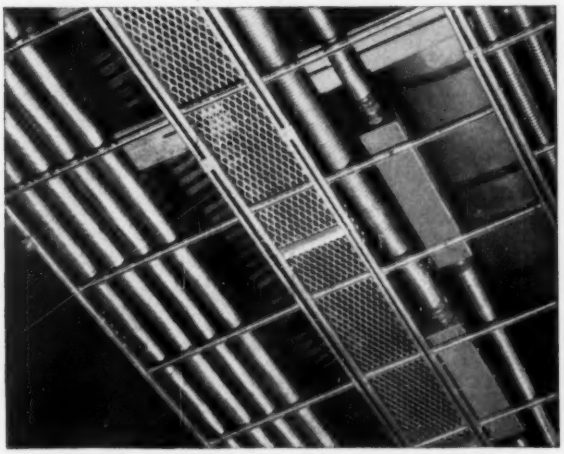
Armorlokt terminates easily. Flexibility of the cable eliminates fussy joint work.



Small radius or large radius curves are easily handled. Space is left for future cable.



Imagine how this would look using old-style conduit. Now it's neat and accessible.



Splices can be made anywhere, an important feature if cable is damaged in service.

USS Tiger Brand Electrical Wire & Cable

A standard cable for every special job

- Asbestos Wire and Cable
- Mold Cured Portable Cord
- Shovel & Dredge Cable
- Paper & Lead Cable
- Varnished Cambric Cable
- Interlocked Armor Cable
- Special Purpose Wire & Cable
- Aerial, Underground and Submarine Cable

USS, Tiger Brand and Armorlokt are trademarks

Check unmarked terminals.

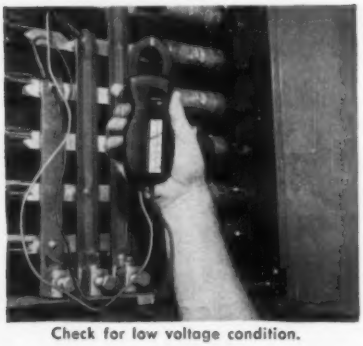
handle 99% of all your test needs with the ALL-PURPOSE AMPROBE RS-3

Check resistance of transformer windings of ballast.

Check resistance of motor control solenoid coil.

Use as continuity tester to determine if fuse is good.

Balancing circuits.



Check for low voltage condition.

There's only one way you can do it . . . with the new AMPROBE RS-3 . . . the only tester small enough to fit in your pocket, yet versatile enough to measure volts, amps, and OHMS!

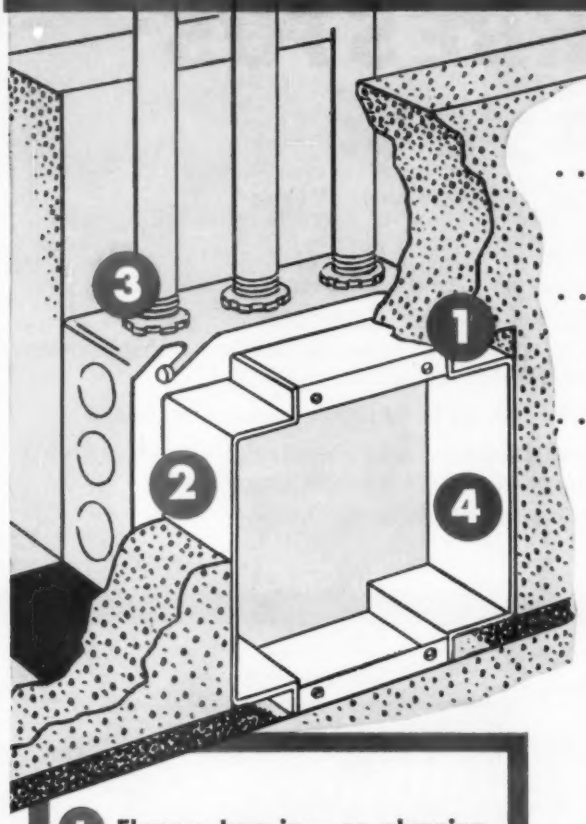
NEW AMPROBE RS-3

Meets every commercial voltage requirement on three voltage scales . . . 0-150/300/600 volts ac. Accurate current readings from 0 to 300 amps on five current ranges. The ohmmeter scale is designed specifically for you . . . readings as low as 0.5 ohms can be taken, enabling you to readily distinguish the difference between short circuits and actual coil resistances.

Doesn't it make a helluva lot more sense to use this one all-purpose instrument than to tote *three* separate testers that can't even come close to AMPROBE efficiency?

Pyramid Instrument Corporation, Lynbrook, N. Y. In Canada: Atlas Radio Corp., 50 Wingold Ave., Toronto

NEW RACO 4" SQUARE TILE COVERS
with device mounting holes inside



. . . . . eliminate drilling or chipping to clear mounting holes

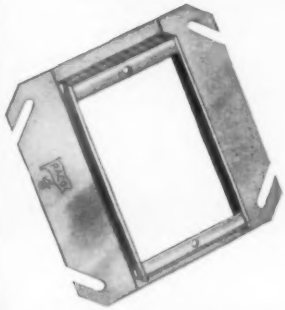
. . . full range of depths - ½" to 2" in single and two-device styles

. . . designed to provide a faster, neater installation

Raco 4" Square Tile Covers simplify and eliminate many installation problems. There's a range of depths in single and two-device for all types of wall thickness which provides a finished appearance and permits easier accessibility in wiring. Engineered for quick, easy mounting. Raco Covers have straight-side design which eliminates chamfering or beveling. Flanges are turned in, keeping device mounting holes from being plugged. This is a big advantage. Investigate the time-saving benefits.

1. **Flanges turn in — no plugging of device mounting holes**
2. **No chamfering or beveling required because of RACO'S straight-side design**
3. **Raco single or two-device tile covers fit any 4" square box**
4. **6 covers—choice of depths for every type wall construction**

You can always rely on Raco



Single-Device Tile Cover

Two-Device Tile Cover

ALL-STEEL EQUIPMENT INC.
AURORA, ILLINOIS

SILICONE RUBBER INSULATED
BY ROCKBESTOS
OFFER YOU:

Excellent dielectric strength — electrical properties remain constant from −130°F to +500°F.

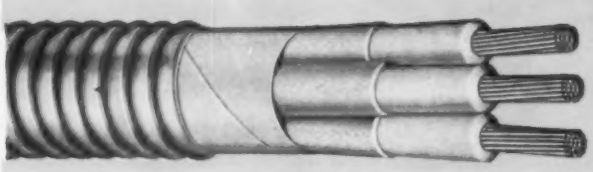
High heat resistance — better than any type rubber insulation. Long service life in temperatures to 125°C (power cables) and 200°C (other applications).

Excellent moisture resistance — unrestricted applications in wet or dry locations — equal to the best grades of rubber. No lead sheath required.

Greater ozone resistance than the best grades of rubber insulated cables.

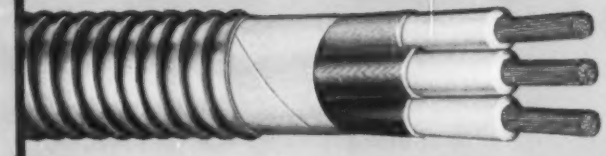
Excellent resistance to chemical attack — being chemically inert, silicone rubber insulations resist effects of lubricating oils and most corrosive atmospheres.

Long life — excellent resistance to weathering and aging.



600 and 5000 VOLT MULTI-CONDUCTOR POWER CABLE

Silicone rubber insulated power cable combined in a 3 or 4 conductor construction, with interlocked armor overall . . . easily installed with simple supports . . . eliminates conduit . . . greater current carrying capacity for economical power distribution.



MULTI-CONDUCTOR CONTROL CABLE

For use in steel mills, power stations, boiler rooms, automotive, ceramic and glass plants as well as other industries where control and signal circuits or control equipment are exposed to high ambient operating temperatures.

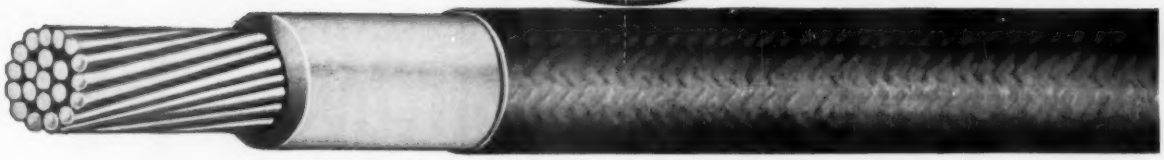
ROCKBESTOS PRODUCTS CORPORATION

NEW HAVEN 4, CONNECTICUT

ROCKBESTOS PRODUCTS CORPORATION, NEW HAVEN 4, CONNECTICUT

NEW YORK • CLEVELAND • DETROIT • CHICAGO • PITTSBURGH • ST. LOUIS • ATLANTA • DALLAS
SEATTLE • LOS ANGELES • BURLINGAME, CALIFORNIA

WIRES

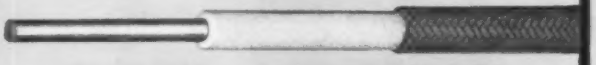


SILICONE RUBBER INSULATED POWER CABLE 600 and 5000 VOLTS

For high temperature circuits either in wet or dry locations, exposed or in conduit. This cable is recommended for use in steel mills, power stations, heat treat areas, boiler rooms, foundries, smelters, etc.

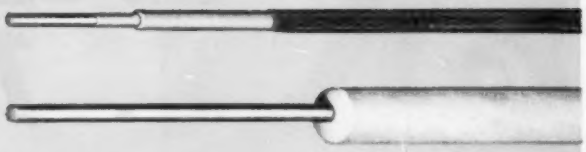
MOTOR LEAD and APPARATUS WIRES

For leads to motors, transformers, etc., requiring a flexible wire in high temperature locations or applications.



APPLIANCE and FIXTURE WIRES

For use in wiring high wattage units when operating temperatures reach 150°C and 200°C. Lighting fixtures, clothes dryers, electronic equipment, stoves, water heaters, ovens, therapeutic devices, space heaters are among the many products for which these wires are recommended.



HEATING CABLES and DEFROSTING WIRES

Heating cables are ideal for use in pipe heating, surface heating, roof de-icing and soil heating.

Defroster wires being odorless and tasteless are perfect for use as rapid defroster heating element in electric refrigerators and freezers.

ROCKBESTOS

For complete details on Rockbestos Silicone Rubber Insulated Wires and Cables send for Catalog SR58.

Thoroughbred performance on every job!

Bull Dog *Tape*

There's a BULL DOG TAPE for every purpose

- **FRICTION**
- **RUBBER**
- **PLASTIC**

BULL DOG TAPE goes on fast . . . sticks tight and stays tight. Splices neatly . . . extra strong and non-raveling. High dielectric strength for complete all-round electrical protection. BULL DOG resists weather and moisture . . . stands up longer on the job. Make BULL DOG *your* pet tape!

Sold only through verified wholesalers

Another quality product of

BOSTON WOVEN HOSE & RUBBER COMPANY
DIV. OF AMERICAN BILTRITE RUBBER CO., INC.
BOSTON 3, MASS.

Continued from page 8

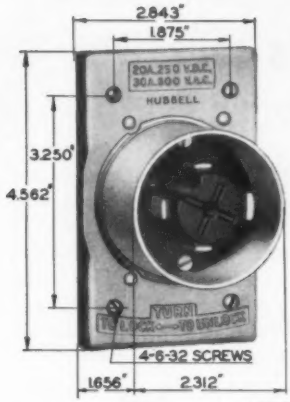
IT PAYS TO HAVE HUBBELL GOOD CONNECTIONS

30 AMPERE

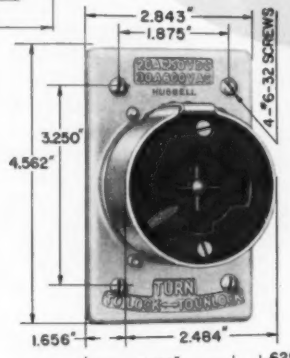
5-WIRE

Hubbellock®

a complete new line of "Hubbellock" devices designed for 4-wire applications requiring additional equipment ground

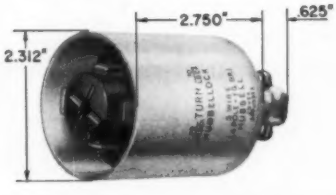


Cat. No. **25418**
Male Receptacle with metal housing



Cat. No. **25403**
Female Receptacle with metal housing

Cat. No. **25414**
Armored Connector Body



Cat. No. **25415**
Armored Male Cap

engineering news

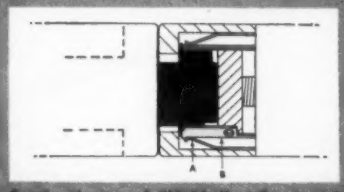
HARVEY HUBBELL, INCORPORATED
Engineering Department

SPECIFIC CONDITIONS INFLUENCING THE USE OF "HUBBELLOCK" CONNECTORS

tacle. In this enforced position it closes up the face of the unit, sealing it against entrance of dust, dirt, moisture, metal filings or other foreign particles that might enter the body of the unit and damage the contacts.

SELF-EJECTING CAP
"Hubbellock" is designed with a safety shutter spring which ejects the cap and snuffs the arc. When the cap is inserted and locked in position a heavy coiled spring is pre-loaded so that when the cap is removed the spring action returns the bakelite safety shutter to its normal position and also acts as a powerful ejector for the cap. The withdrawal of the cap, therefore, is lightning fast, which means that the break arc is extinguished almost instantaneously. This fast snuffing of the arc prevents burning of the contacts, a problem encountered when the break is dragged out slowly.

CONSTANT CONTACT PRESSURE
Positive contact is the best possible insurance against costly interrupted production and down time. "Hubbellock" constant contact pressure is provided by supplementary tension contact springs fitted into the bakelite in back of the contact blades and pressing against them, thereby pre-loading the blades and assuring more positive contact.



Sectional view of "Hubbellock" cap and connector body showing position of cap when twisted into locked position. Note how supplementary tension springs (A) press against, or pre-load, contact springs (B) to assure firm pressure against brass contacts in the hub of the cap.

HARVEY HUBBELL, INCORPORATED
BRIDGEPORT 2, CONNECTICUT

WIRING DEVICE OFFICE AND WAREHOUSE LOCATIONS

Bridgeport 2, Connecticut
State and Bostwick Streets

Chicago 7, Illinois
37 South Sangamon Street

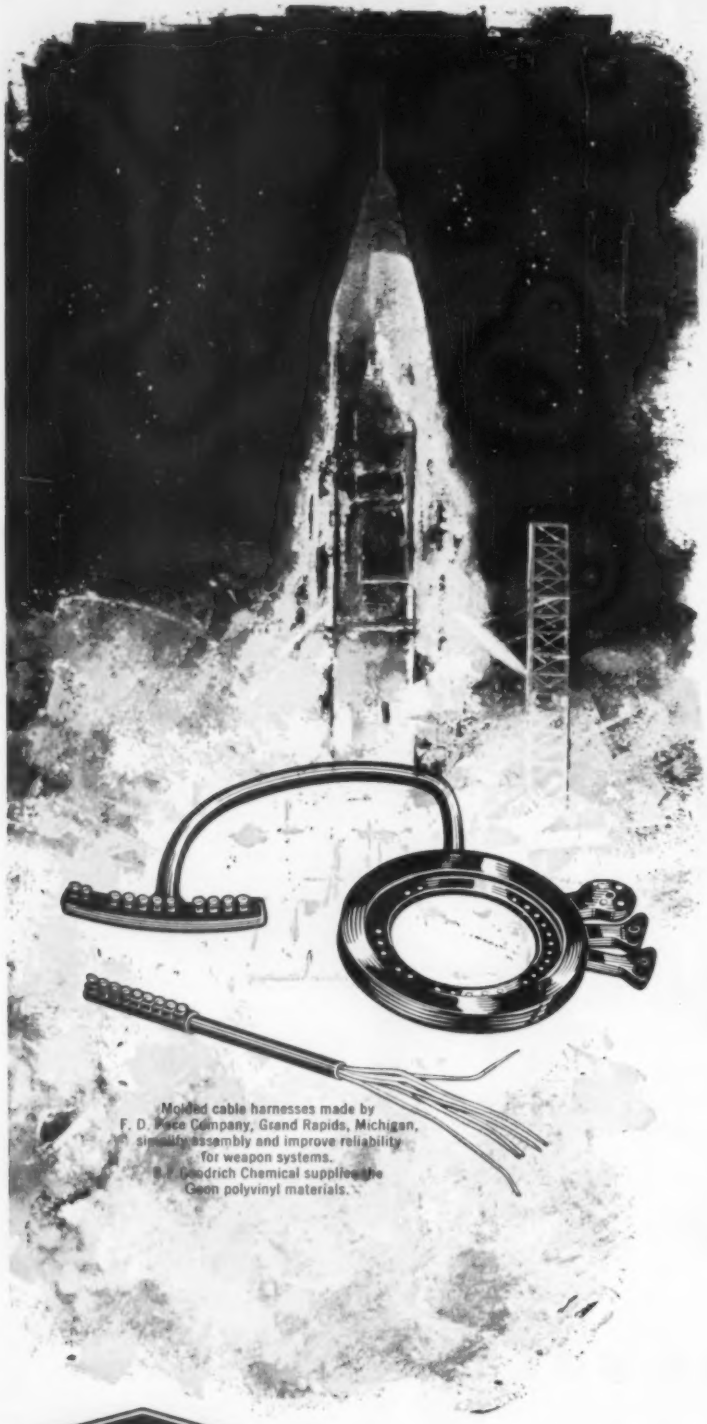
Los Angeles 12, California
103 North Santa Fe Avenue

San Francisco, California
1675 Hudson Avenue

IN CANADA:
Scarborough, Ontario,
1160 Birchmount Road

Another new development using

B.F.Goodrich Chemical *raw materials*



Molded cable harnesses made by F. D. Pece Company, Grand Rapids, Michigan, simplify assembly and improve reliability for weapon systems. B.F.Goodrich Chemical supplies the Geon polyvinyl materials.

Molded cable made with Geon guards weapon's sensitive "nervous system"

Firing modern weapons calls for extreme reliability—especially in the maze of interconnecting electrical components. To meet the needs of these complex installations, a new method of molding wiring harness and cable with Geon polyvinyl material has been developed that promises wide application on tough industrial applications, too.

Geon has many properties which make it ideal for moldings like this. Geon resists attack by most chemicals, heat, light and fungus. Geon also makes possible the right degree of flexibility and physical strength, which means that part of the load is taken off conductors and soldered joints. Since strain cables can be molded in, space consuming clamps can be eliminated. In addition, contacts, terminals and connectors can be molded to exact position to eliminate misconnections.

Geon also permits molding in any color to simplify coding. It's another example of the many ways Geon can contribute to new products or applications. Write Dept. LS-1, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

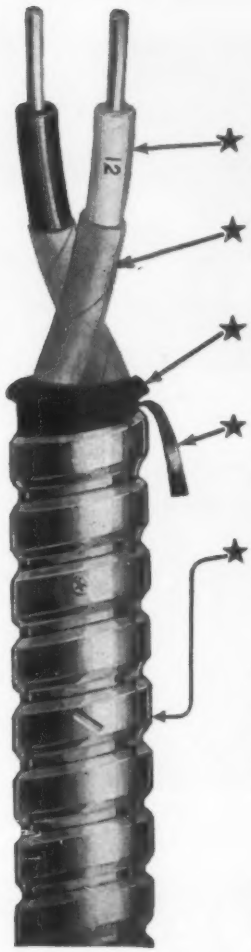
B.F.Goodrich

GEON polyvinyl materials • HYCAR rubber and latex
GOOD-RITE chemicals and plasticizers • HARMON colors

CRESCENT

ABC ARMORED CABLE TYPE ACT

IS EASIER AND QUICKER TO INSTALL



★ PLASTIC INSULATED CONDUCTORS are clean, easy stripping, with solid, clear colors, and minimum diameter for easier installation in boxes.

★ PAPER TAPE which is tough, moisture-resistant yet easily removed, gives protection to the insulated conductors.

★ INSULATED BUSHING for protection against sharp ends of armor, furnished with each coil of cable.

★ BOND STRIP UNDER ARMOR is used in all sizes. A flattened aluminum bonding wire in contact with the under side of each convolution of the galvanized steel armor assures a permanent, low resistance through armor to ground.

★ PREFABRICATED BREAKING LINES. At intervals of every 1½ inches on CRESCENT ABC Armored Cable you will find a small cut mark. This cut mark shows the location of a prefabricated breaking line inside the armor.

Only a few short strokes of a hacksaw guided by the cut mark are required to cut through ONE outer ridge, and a bend by hand severs the armor. By actual test, this saves 30% of the time ordinarily required. A clean separation results, with no sharp edge. There is no chance of injury to insulation because only one OUTER ridge is cut.

The prefabricated breaking lines in the armor are so made that THERE IS NO REDUCTION of tensile strength, bending qualities, crushing resistance or electrical conductivity. This armor construction meets all requirements of Underwriters' Laboratories.

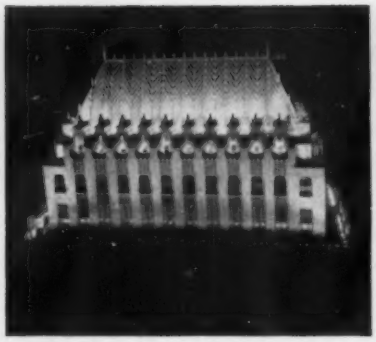
CRESCENT WIRE & CABLE

OVER 70 YEARS EXPERIENCE

CRESCENT INSULATED WIRE & CABLE CO.

Trenton, New Jersey

PERIMETER LIGHTING helps prevent trespassing and costly pilfering.

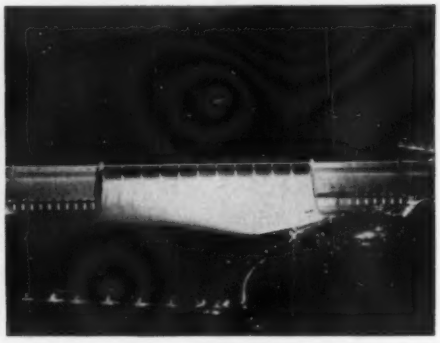


ARCHITECTURAL LIGHTING will add prestige and beauty to buildings.

SHOPPING CENTERS boost night-time business when brightly lighted.

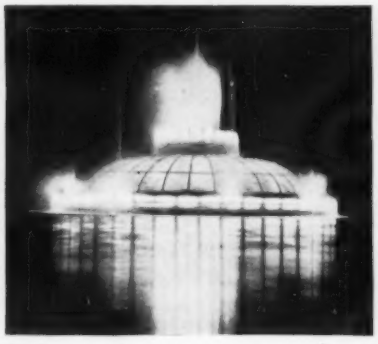
LOADING DOCKS become safer, more efficient when properly lighted.

FACADE LIGHTING gives safety, identification to building and store fronts.



GRAND COULEE DAM lighted by 742 General Electric 1500-watt floodlights.

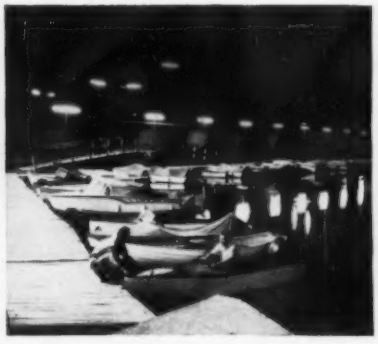
RAILROAD YARD lighting cuts accidents, thefts, and costly freight damage.



FOUNTAINS assume day-time beauty with brilliant, multi-colored floodlights.

NIGHT CONSTRUCTION is safer and more practical with floodlighting.

ATHLETIC FIELD lighting lengthens the time available for fun and play.



DOCK FACILITIES nighttime usage is greatly increased with floodlights.

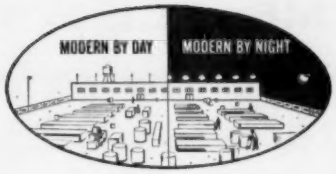
TENNIS COURTS attain round-the-clock use with modern floodlighting.

STORAGE YARDS can be just as accessible at night as they are by day.

PLANT ENTRANCES need modern lighting to facilitate visitor checking.

GUIDE SIGN lighting adds convenience, safety to highway travel.

AIRPORTS become safer, and more convenient with proper floodlighting.



When light means more safety, fun, beauty, or efficiency, General Electric floodlights will do it best—at least cost

As floodlights in these 16 areas are switched on there is an immediate addition of beauty, safety, efficiency. Nighttime crowds fill the lighted recreational areas; movement of raw materials and finished goods is speeded on lighted loading docks; a fountain with multi-colored lights becomes a nighttime landmark.

These are typical results of proper outdoor lighting. The benefits are many—the applications unlimited. But, regardless of the job to be done—from Grand Coulee Dam to highway guide signs, from Milwaukee's County Stadium to railroad yards—General Electric has the experience to do the job best . . . and a full line of floodlights designed to do it at least cost:

FILAMENT OR MERCURY LIGHTING is simple with any of General Electric's L-69A (high efficiency), L-100 (general-purpose enclosed), or L-55 (economy open-type) units. Each of these floodlights features G.E.'s exclusive "diamond back" reflector . . . designed to deliver from 5% to 35% more light . . . and distribute it more uniformly.

FLUORESCENT LIGHTING units are available in 4-, 6-, and 8-foot lengths. Two housings are offered—one for G.E.'s High Output lamps—the other for G.E's Power Groove lamps.

Here's an added benefit—over 500 conveniently located distributors ready to supply G-E floodlights from stock or by prompt shipment. Call one of them—or send in coupon below:

GENERAL ELECTRIC

Section A450-17, General Electric Company, Schenectady 5, N. Y.

Please send me free information on:

☐ Filament floodlighting ☐ Mercury floodlighting ☐ Fluorescent floodlighting

Name_____

Street_____

City_____ State_____

MR. ELECTRICAL CONTRACTOR:

LOOK ADS

INTRODUCE YOU AS A

HOUSEPOWER
TRADE MARK

SPECIALIST

TO HELP YOU

SELL MORE, EARN MORE

The entire HOUSEPOWER program this year focuses on you. Yes, you—the electrical contractor.

Right now HOUSEPOWER Phototest ads are preselling homeowners on the need for full HOUSEPOWER . . . and telling readers what to do to get it: Call you, a "HOUSEPOWER Specialist."

EVERYTHING YOU NEED TO WIRE UP PROSPECTS FOR PROFIT:

HOUSEPOWER Campaign Guide

Shows you tested ways of making the big LOOK HOUSEPOWER series pay off for you. Shows specific ways that you can profit as a HOUSEPOWER Specialist in your area.

Direct Mail Materials

Folders to fit all your direct mail needs: Ideal for follow-ups with prospects; perfect for leaving with neighbors of customers. Space for your imprint. Catalogue shows folders illustrated in detail. Send for it.

Ad Materials for your own Dynamic Local Campaign

The most live-wire ad mats yet devised to get you direct line leads. Each mat, in the economical size, is built around a HOUSEPOWER Phototest. Homemakers have fun with the test, learn how to get in touch with *you* to get a HOUSEPOWER Rating.

Special HOUSEPOWER Phototest Folder

The best door opener ever! Here, in one folder, Edison Electric Institute has reprinted all the HOUSEPOWER Phototest ads which appear in LOOK. Each page directs the homeowner to you. It's a big (LOOK size) folder which sells *your* services. Your name can go on it, of course.

Plan now to make Spring '59 your most profitable season ever. The hard-selling, sales pulling power of LOOK and the HOUSEPOWER Phototests are all planned for your benefit. In addition, HOUSEPOWER ads will back your sales program all through the year. Take advantage of the best business building plan ever offered. Check with your local electric utility or association to find out how you can become a HOUSEPOWER Specialist in your area. Or write to us.

National Wiring Bureau
155 East 44th Street
New York 17, N. Y.

a sponsor of **HOUSEPOWER**
TRADE MARK

4'-square PLEXIGLAS diffusers at Park Avenue office of a large New York City bank

PLEXIGLAS

...for lighting that stands out and stands up!

For lighting equipment that matches the beauty of a handsome interior, choose luminaires incorporating PLEXIGLAS® acrylic plastic. Then you can be sure of clean, uncluttered appearance, and highest efficiency in transmission and diffusion. You can also be sure these advantages will last, because PLEXIGLAS has freedom from discoloration, resists breakage, is a rigid material with a smooth, easily cleaned surface.

We will be glad to send you white translucent samples and a copy of our brochure, "Architectural Lighting with PLEXIGLAS".

Chemicals for Industry

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

Canadian Distributor: *Crystal Glass & Plastics, Ltd., 130 Queen's Quay East, Toronto, Ontario, Canada.*

Diamond has all 3 portable cords

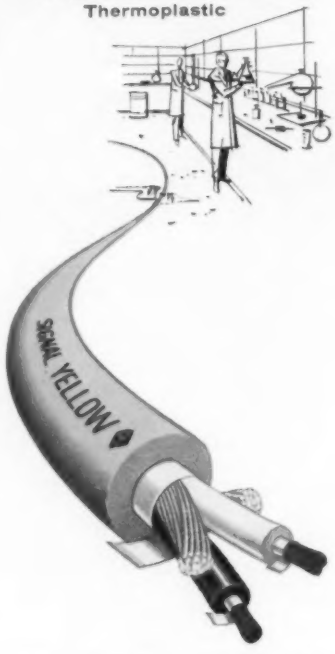
Red-D-Prene®
Neoprene Sheathed

for hot, oily locations

Black Diamond
Rubber Sheathed

for general purpose use

Signal Yellow
Thermoplastic



for all locations where heat is no problem

Red-D-Prene for mill and plant use is designed with tough, oil, heat and flame resistant Type MD (Mill Duty) neoprene jacket in industrial red for ready identification.

Black Diamond has durable rubber jacket protecting against alkalies, acids and moisture. Very flexible construction prevents kinking in service.

Signal Yellow has a jacket of yellow thermoplastic that is quickly seen . . . clean to handle . . . smooth sheath will not readily collect dirt. Easy to pull.

ORDER FROM DIAMOND TODAY!

Trade Mark

DIAMOND
WIRE and **CABLE** Company
Sycamore, Illinois
WAREHOUSE: BIRMINGHAM, ALABAMA

Superintendent of Schools:
Dr. O. E. Hill

Assistant Superintendent:
Dr. R. Y. Leech

Architect:
Spahn & Barnes,
Cleveland, Ohio

Electrical Engineer:
Mehnert & Reid,
Cleveland, Ohio

Electrical Contractor:
California Electric
Construction Co., Inc.
Parma, Ohio

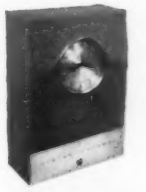
They wanted the best modern time and program system at the $2,225,000 Frank Wiley Junior High School in Cleveland Heights, Ohio.

They chose a STROMBERG Time and Program System

FEATURES OF STROMBERG SYSTEMS INCLUDE:

- Jeweled Master Clock movement with automatically wound 72-hour spring power reserve.
- Secondary Clocks standard with hourly and 12-hour supervision—correction cycles completed in *only 60 seconds.*
- Program Unit, capable of 1440 signals daily on each circuit, immediately resets following power interruption.
- Central operations panel for control of utilities.
- Seven-channel transmitter—one for clock supervision, six for program signals.
- Installation and maintenance service available throughout U.S.A. and Canada.

A product of the laboratories of one of the largest clock manufacturers in the world—YOUR GUARANTEE of performance, quality and dependability.



A complete catalog—TIME AND SIGNAL EQUIPMENT—prepared especially for Architects and Engineers—is yours for the asking.

Stromberg TIME CORPORATION
ELM STREET, THOMASTON, CONNECTICUT

GT GENERAL TIME — SUBSIDIARY OF GENERAL TIME CORPORATION

Sales & Service Offices throughout the U. S. A.

Leading Industries and Architects Use American Lighting Louvers

Because American Plastic Louvers illuminate hallways, cafeterias and conference rooms, they are employed to give soft and glare free, efficient, inexpensive visual comfort. They are maintenance free. So for the ultimate in modern lighting design, specify American Plastic Louvers.

FOR CONTRACTORS AND ENGINEERS

There is a total absence of welding, riveting, and surface brightness with American Plastic Louvers. Their open construction permits freedom of air flow, helps diffuse heat or air conditioning, and allows free sprinkler operation.

Our engineers in your area are available to help with your lighting problems. For additional information, write for a detailed bulletin.

The dining area is lighted by troffers on a beam centerline flanked by 4 ft. wide continuous strips of plastic louvered ceiling. Deluxe warm white tubes on 8 inch centers are operated at 200 milliamps.

CREDITS

- Architects: *Wilton Becket and Associates, Los Angeles*
  Albert Kahn and Associates, Detroit
- Electrical Installation: *Triangle Electric Co., Detroit*
- Lighting Fixtures: *Fullerton*

SPECIFY AMERICAN PLASTIC LOUVERS . . .
AND BE SURE OF THE BEST IN
MODERN LIGHTING DESIGN

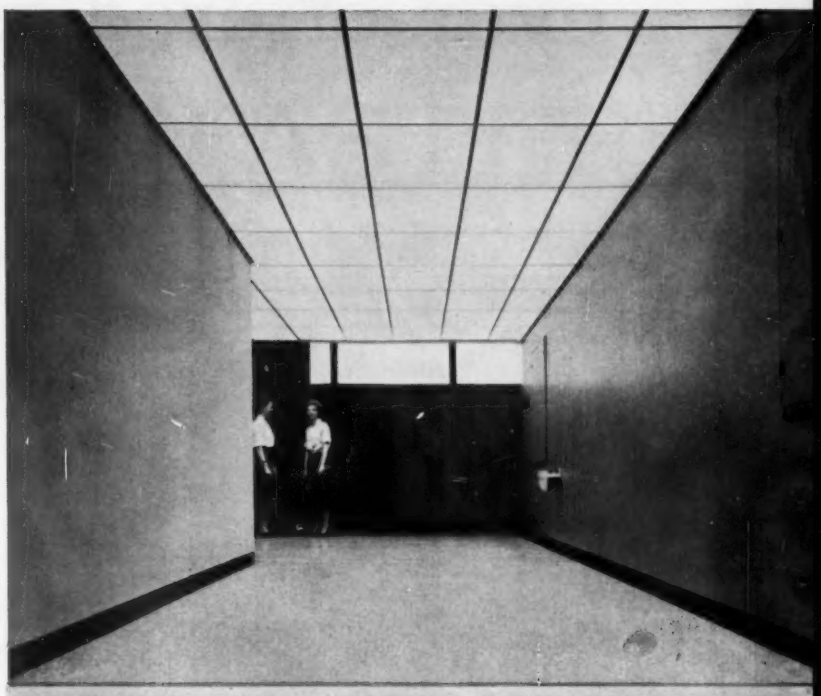
american louver company

4240 NORTH SAYRE AVENUE • CHICAGO 34, ILLINOIS

USA Pat. No. 2,566,817
USA Pat. No. 2,607,455

Canadian Pat. No. 484,346
Canadian Pat. No. 497,047

Why Lustrex* Perma Tone Styrene for ceilings?



Louvers made by American Louver Company of Lustrex perma tone. Installation by Triangle Electric. In Ford lobby luminous ceiling with 45° shielding lights 1100 sq. ft. Height to louvers: 12'; lamp spacing: 18"; ceiling brightness: 111 F.L.; walls: 10 F.L.; floor: 24 F.L.

In 90 x 120 ft. cafeteria, louvered strips, 4 ft. wide, run horizontally under ventilating ducts. Depth of cavity: 6½". Ceiling brightness: 220 F.L.; tables: 85 F.L.; floor: 29 F.L.

3 TIMES MORE COLOR STABILITY THAT'S WHY!

One of the striking features in Detroit's new Ford Division General Office Building, designed by the famous architectural firms of Wilton Becket & Associates of Los Angeles and Albert Kahn & Associates of Detroit, is the use of luminous ceilings. Halls, cafeterias, and conference rooms are softly, beautifully lighted by the glare-free illumination provided by Lustrex perma tone white styrene louvers.

To all the obvious advantages of styrene in lighting (large areas of illumination, light weight, good diffusion, unusual design effects), Lustrex perma tone adds excellent ultra violet stability. Specially developed to meet ES–NEMA–SPI joint specifications, Lustrex perma tone offers truly translucent whites and a wide range of colors. Write for free technical report on perma tone, including accelerated test results and other valuable data on styrene in lighting fixtures to Monsanto Chemical Company, Plastics Division, Room 1331, Springfield 2, Mass.

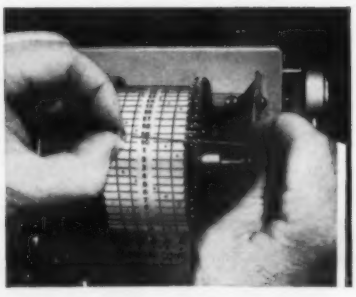
Monsanto

*LUSTREX: Reg. U.S. Pat.

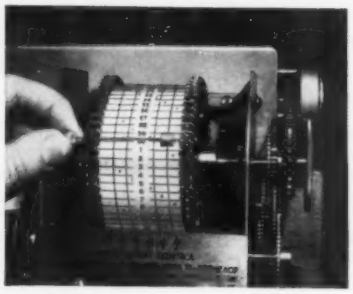
The most dependable ever offered now backs

AS AN ADDED BENEFIT TO YOUR CLIENTS—CLOCKMASTER PROGRAMMING IS THE EASIEST TO SET:

1 The same setting wheel used for setting master clock to the correct time is used to set the programmer. Time and program bells are always in step with one another.



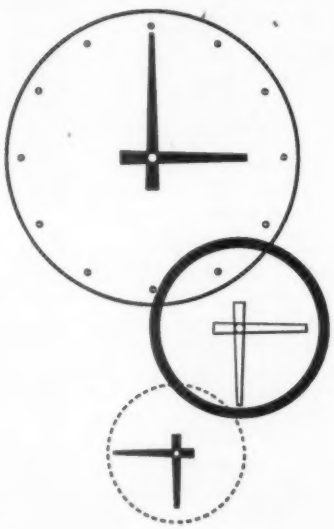
2 Then, simple, reusable steel pin is inserted in chain link opposite minute mark indicating time signal is to sound. Light section is day, dark section is night.



3 Reusable plastic roller slides onto pin, without special tools, to sound program-signal. Any signal can be changed without affecting any other part of program.

nationwide service up HONEYWELL'S CLOCKMASTER* SYSTEM

A Honeywell expert is always on hand, beginning with initial clock and programming planning . . . continuing through years of efficient, convenient service.



Honeywell sales engineers work closely with architects and engineers in planning a master time and programming system.

During installation, experienced Honeywell installation supervisors are present to answer any questions and check the finished job. Once the system is in operation, Honeywell's factory-trained men provide free service for one year. Then Honeywell offers a low-cost maintenance plan that includes regular inspections and prompt, efficient service by skilled men who are available immediately when needed from 112 Honeywell offices throughout the country. There is one in your area.

Handsomely-designed Honeywell clocks come in dial sizes of 9, 12, 15 or 18 inches. They may be flush or surface mounted. They're easy to install and have standard plug-and-socket connections.

For more information about Honeywell's Master Time and Programming Systems, call your nearest Honeywell office. Or write Minneapolis-Honeywell, Dept. EC-2-04, Minneapolis 8, Minnesota.

*Trademark

Honeywell

H HONEYWELL First in Control

For specification details see Sweet's Architectural File 33b/Mi.

New rapid-start ballast for two 40w lamps proved under severe test conditions

New cool Sola rapid-start ballast easily passes "in-fixture" heat tests

Sola engineers the ballast to be an integral part of the fixture rather than as an isolated component. This new ballast was consequently designed to pass exacting "in-fixture" tests, for superior performance under the most demanding operating conditions.

This new two-lamp, 40-watt, rapid-start ballast is built to allow a coil-temperature rise of only 42°C when tested according to U.L. and E.T.L. methods.

In our own laboratory the new ballast was installed in a four-lamp fixture, completely enclosed and surface-mounted on acoustical material. Temperature in the fixture channel was 18°C hotter than the usual 40°C ambient of U.L. and E.T.L. tests. The following impressive results were recorded:

- Maximum coil temperature was 89.3°C—15°C cooler than the limit of Class A insulation.
- Temperature of the capacitor's case was within the heat limits of the capacitor's insulation.
- The "hot-spot" temperature on the ballast case was 81°C — 5°C cooler than premium-priced ballasts similarly tested, 9°C cooler than the maximum allowed under U.L. fixture requirements.

Our new level of coolness in ballast case, coils and capacitor contributes to full ballast life. This premium performance is offered at no price penalty.

Sola will furnish fixture manufactures with samples of this new ballast (Catalog No. 670-109). Write to us on your business letterhead, and a Sola sales engineer will promptly supply your test ballasts. Sola welcomes the challenge of having you evaluate this cool new ballast in your own fixtures. If you wish merely to examine data on the new model, please request Bulletin FL-352. Write to the Manager, Lighting Sales.

Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill., Bishop 2-1414 • Offices in principal cities • In Canada, Sola Electric (Canada) Ltd., 24 Canmotor Ave., Toronto 18, Ont.

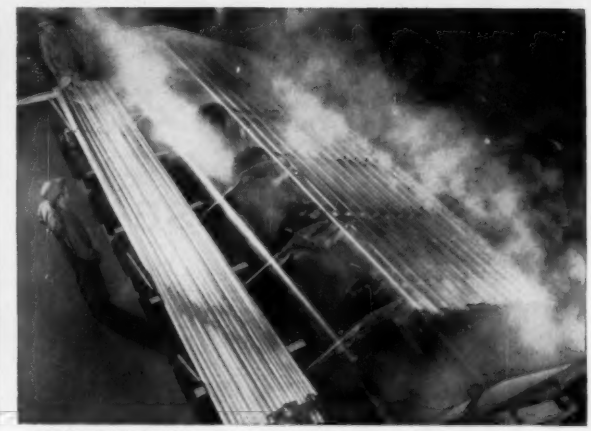
A DIVISION OF BASIC PRODUCTS CORPORATION

These 4 steps show why SPANG brings you the best galvanized steel conduit!

THOROUGH CLEANING of the conduit before galvanizing removes all dirt, grease and scale, leaves a clean surface for the prime western zinc galvanized finish.

STEAM-WIPING of the conduit's exterior, as it comes from the kettle through an air ring, produces a smooth even finish that will stand up under severe bending.

SUPERHEATED STEAM blown through the conduit interior removes excess zinc inside, assures a smooth, uniform surface for easy wire pulling.



QUICK QUENCHING of the conduit in a sodium dichromate solution bonds the galvanized finish to the steel, adds extra service life, helps prevent white rust formation.

This is just part of the *quality-control* processing that each length of Spang HD Galvanized Conduit receives. Careful control from skelp through the inspection tables assures you of a *top-quality* conduit for *top-quality* installations. Try it on your next job! Your local Spang Distributor is at your service!

THE NATIONAL SUPPLY COMPANY

SPANG® CONDUIT

Subsidiary of Armco Steel Corporation

TWO GATEWAY CENTER, PITTSBURGH, PA.

ACTUAL SIZE MARK 75 HF FRAME

WESTINGHOUSE

ANNOUNCES

MARK 75

Now! Molded Case Circuit Breakers that interrupt **75,000** amperes

Available at only a fraction of the cost of other high-interrupting capacity breakers!

This is news that can literally save you thousands of circuit breaker dollars. Westinghouse has developed a new molded case breaker line, the MARK 75, that can be used on high-power applications up to 75,000-amp capacity (240 v a-c).

The MARK 75 exclusively gives you . . . an extremely high-interrupting capacity molded case breaker . . . without reactors or fuses . . . at a fraction of the cost of equivalent devices . . . in the same frames, and interchangeable with the standard line of Westinghouse AB circuit breakers (see actual size illustration at left).

You can order MARK 75 circuit breakers in three frame sizes—HF, HKL and HLM—by contacting your nearby Westinghouse sales representative. Or by writing: Westinghouse Electric Corporation, Standard Control Division, Beaver, Pa.

If you'd like information on other major Westinghouse circuit breaker innovations of 1958—Saf-T-Vue*, Tri-Pac*, JK and JKL—ask us for bulletins on these also.

*Trade-Mark

J-30261

YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS

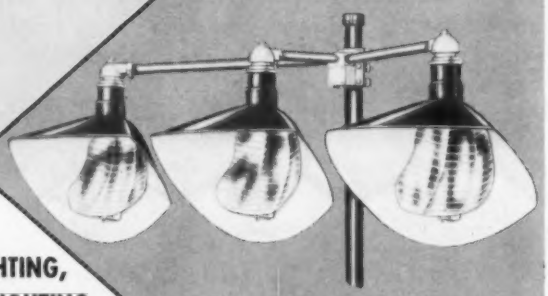
37 Years
OF LEADERSHIP
IN THE MANUFACTURE OF INCANDESCENT LIGHTING EQUIPMENT

Vapor Proof

RLM Standard Dome with QUAD EASY-TACH

QUAD
LIGHTING

RLM High Bay with QUAD EASY-TACH



Flood Lights

FLOOD LIGHTING, INDUSTRIAL LIGHTING AND SIGN LIGHTING

MAIL COUPON TODAY

QUADRANGLE MANUFACTURING CO.
Dept. 62, 32 S. Peoria St., Chicago 7, Ill.
Gentlemen: Please send me your Complete Catalog.

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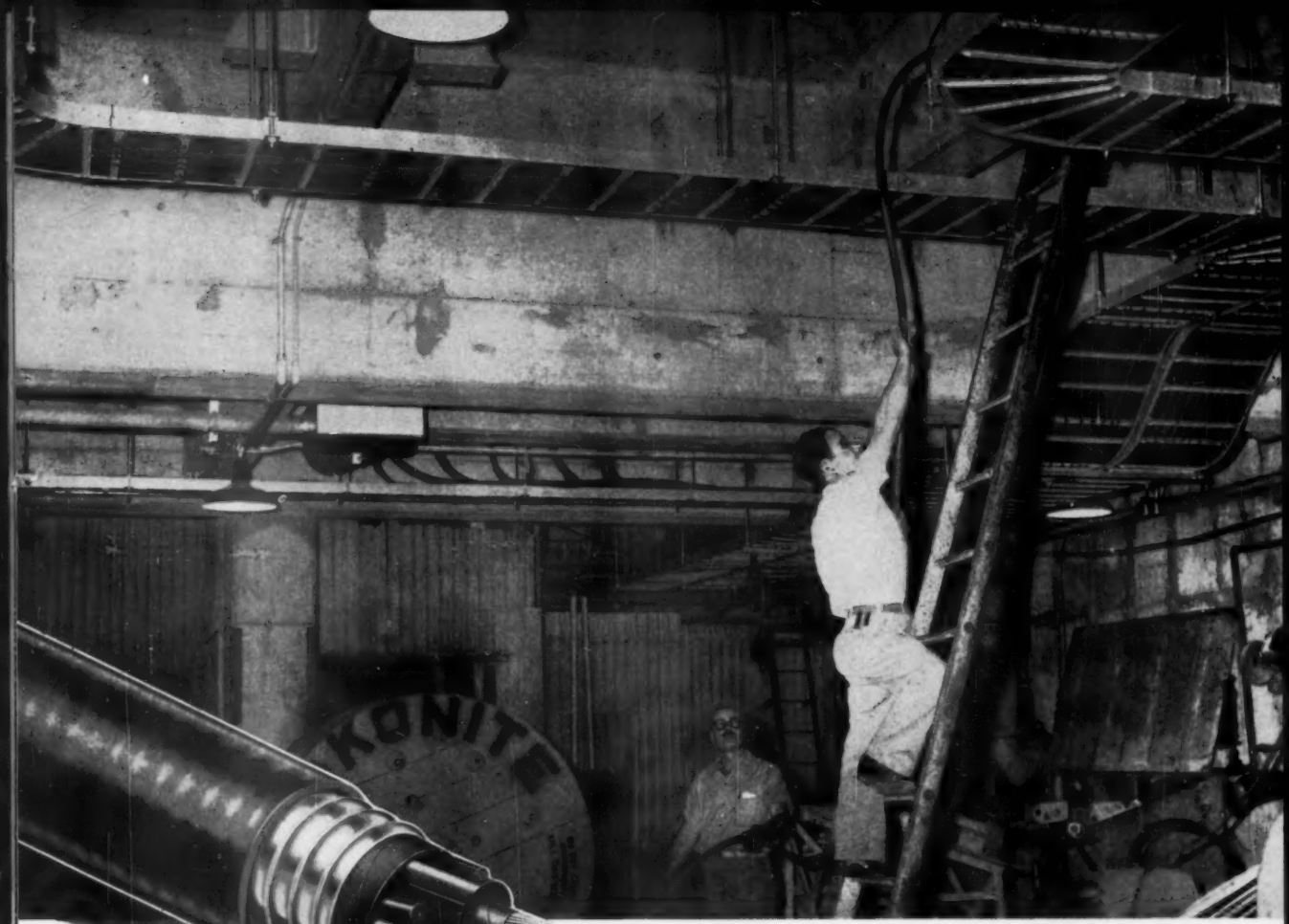
QUADRANGLE RLM

AMERICA'S MOST COMPLETE INCANDESCENT (RLM) LINE



THE RIGHT CABLE FOR EVERY POWER CIRCUIT in Brunswick's new bleach plant is provided by Okonite problem-solving constructions. Racks above contain 4160-volt Okolite-Okoprene power cables with aluminum Loxarmor and protective green Okoseal jacket together with other Okonite-designed 440 and 660-volt power cables with identifying blue Okoseal jackets and 250-volt control cables.

Okonite cable gives Brunswick Pulp & Paper maximum protection in chemical atmosphere—at lower costs

PROBLEM: For one of its vital electrical circuits, Brunswick Pulp and Paper Company's new bleach plant for modern, high-graded processes needed a primary distribution cable of 4160-volt capacity that could stand up to chemical attack. Mindful of the penalties of plant down time they sought maximum circuit security. They also wanted lower installation costs.

SOLUTION: They got both a superior cable and a less expensive installation by using Okolite-Okoprene 5kv cable with an aluminum Loxarmor covering and Okoseal jacket.

HERE'S WHY: *Okolite insulation*, applied by Okonite's exclusive strip process for maximum quality control, is moisture, ozone and heat resistant with lasting high dielectric strength. *Okoprene sheath* gives positive protection from moisture and most harmful acids, oils and chemicals. Lightweight *Aluminum Loxarmor*, for use in racks, eliminates the installation expense and the difficulty in changing a conduit system. *Okoseal* PVC (polyvinyl chloride) jacket was selected to counter specific chemical conditions in the plant. Colored green, it also identifies the primary circuit.

Okonite makes cables by all the known methods, has a background of 80 years of experience. You will get sound and unbiased recommendations when you call on your Okonite representative. In the meantime, ask for Bulletin EC-1117 on "How to Choose Insulated Cable."

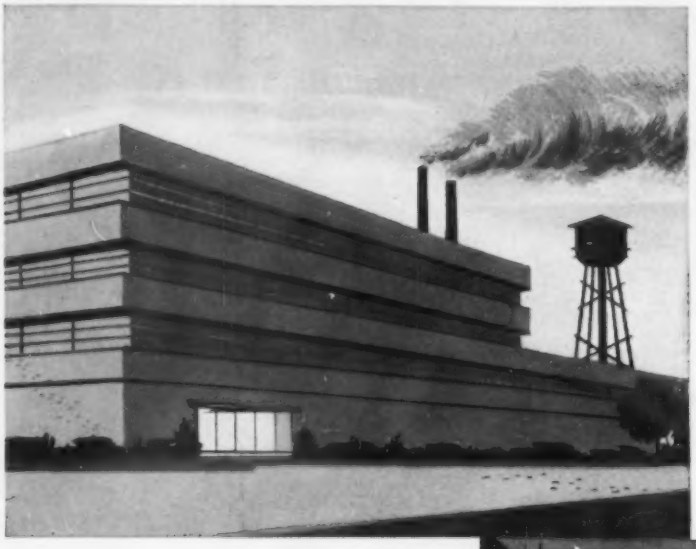
THE OKONITE COMPANY
Subsidiary of Kennecott Copper Corporation
Passaic, New Jersey

where there's electrical power . . . there's **OKONITE CABLE**

6377

TREMENDOUS MARKETS

for Exide Lightguard emergency lighting units



Industrial

Easy to sell

Every factory *needs* protection against sudden darkness. If lights go out, they risk heavy losses . . . from injury, panic, equipment damage. Exide Lightguard® units give complete protection. Most customers buy several. Profits for you are substantial. Try it and see.

Commercial

Untapped potential

Stores and restaurants, offices and theaters need light in key areas all the time. Sudden darkness gives thieves a field day. Crowds panic. Yet the fact is most businesses still don't have emergency lighting. Be first to profit. Tell them the Exide Lightguard story.

Easy to install. Completely self-contained. Exide Lightguard units plug into regular power outlets. Go on automatically if power fails. Flood large areas with light. Only Exide Lightguard offers the extra safety of genuine Exide batteries and built-in charger. Better protection. Less cost per year. For information on becoming an Exide Lightguard dealer, write Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

Exide®

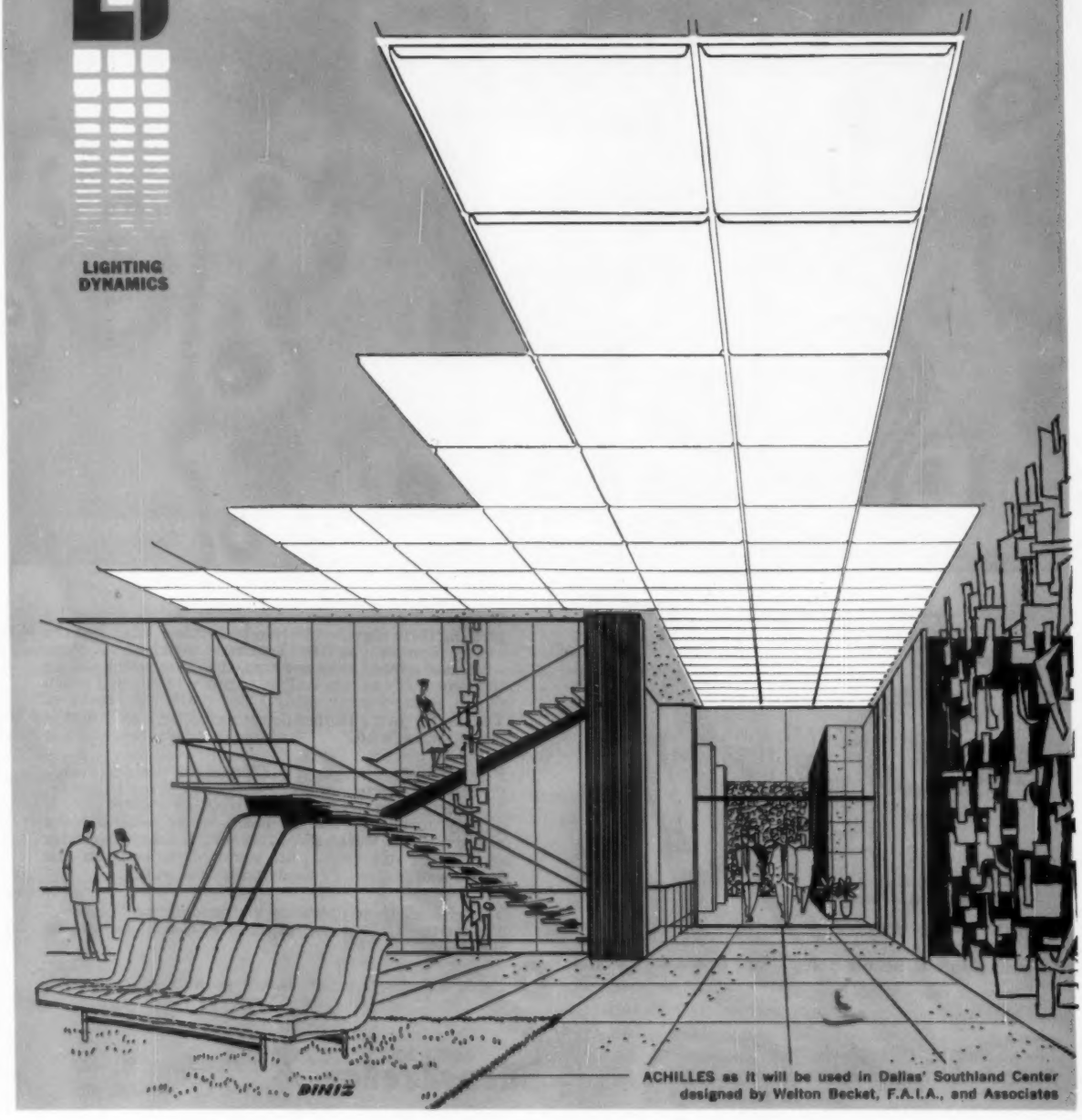
problem

An easily maintained, integrated fixture was needed for Welton Becket's dramatic "squares of light" ceiling in the lobbies and offices of Southland Life's spectacular 42-story Southland Center in Dallas.

solution

ACHILLES by Lighting Dynamics was specified for the lobby... and it's companion Apollo was used in the offices throughout the center. Achilles is a highly versatile fixture series ideal for this demountable acoustical ceiling—just as it is for countless other ceiling suspension systems. It's quickly installed with a drop-in installation and has easy maintenance with press-to-open catches and hook-on hinges. Durable, Bonderized and electro-static, high-reflectance finishes... FOR MORE COMPLETE INFORMATION, call your Lighting Dynamics representative, or write to Lighting Dynamics, 802 West Whittier Blvd., Whittier, California or Lighting Dynamics, 8700 Ambassador Row, Dallas, Texas.

LIGHTING DYNAMICS

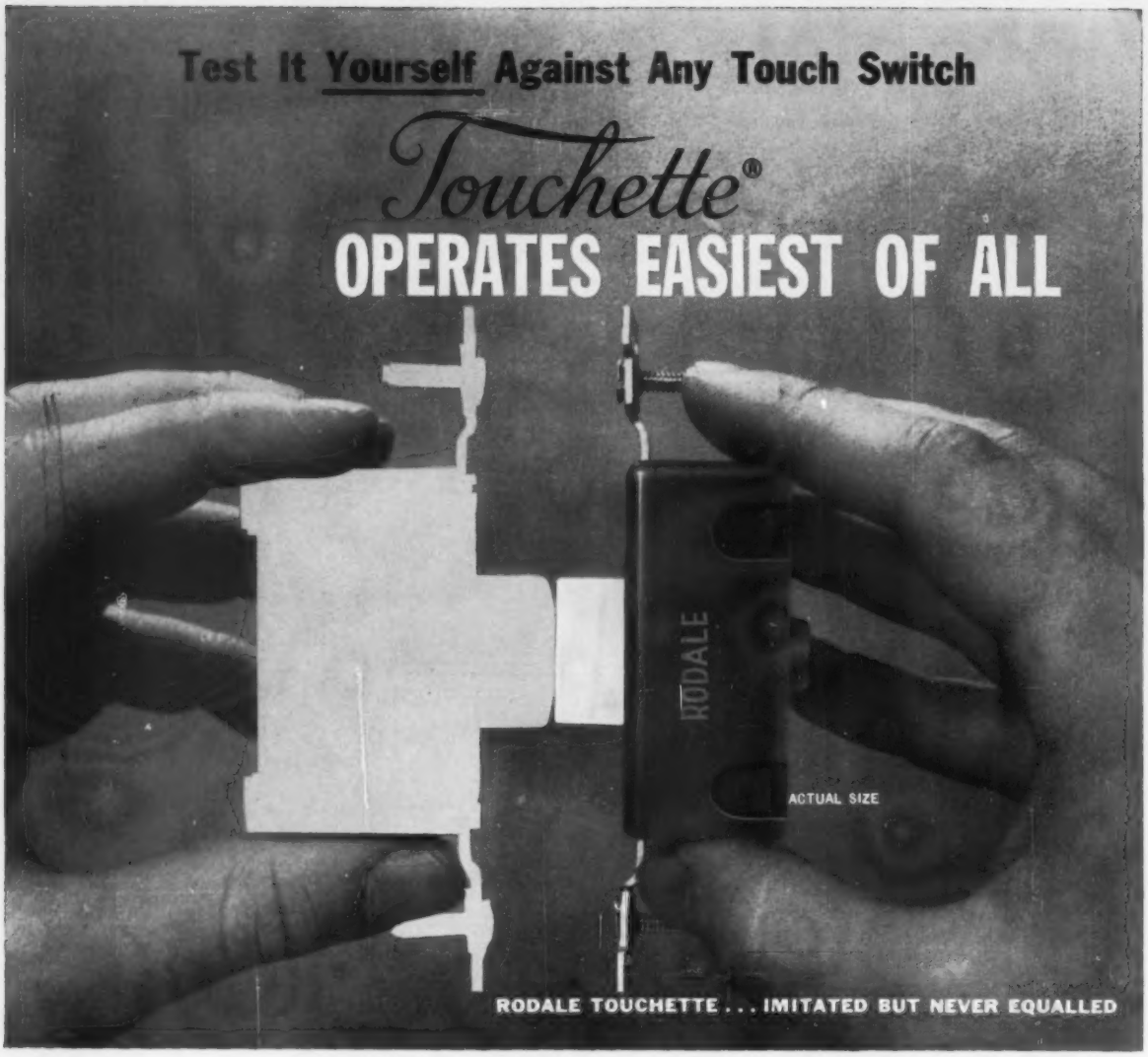


ACHILLES as it will be used in Dallas' Southland Center designed by Welton Becket, F.A.I.A., and Associates

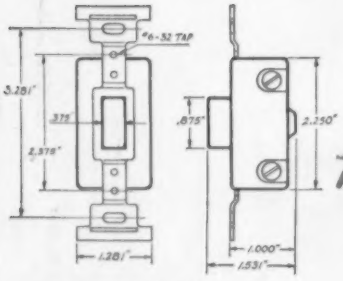
Test It Yourself Against Any Touch Switch

Touchette®

OPERATES EASIEST OF ALL



RODALE TOUCHETTE . . . IMITATED BUT NEVER EQUALLED



U. S. Pat. No. 2,820,113
other patents pending foreign patents applied for

UL LISTED—CSA APPROVED

In single pole, double pole, 3-way and 4-way models.
Brown or ivory touch button.

Compare Touchette with any touch switch simply by pressing them together, button to button. With just the merest pressure, you'll see Touchette switch on . . . then, with considerably more pressure, the other switch will do the same. It's as easy as that to prove to yourself which switch actuates more easily. For that's the beauty of Touchette. Just a feather-light touch . . . it's on. Another touch, and it's off.

Feature for feature, you'll find Touchette the ideal switch for new construction or remodeling jobs. Easy to handle, Touchette measures *just one inch in depth* . . . is quickly installed even in boxes where several wires already enter. Rated 15A-120-277V, Touchette operates on full line voltage . . . fits standard outlet boxes and toggle wall plates . . . needs no special wiring.

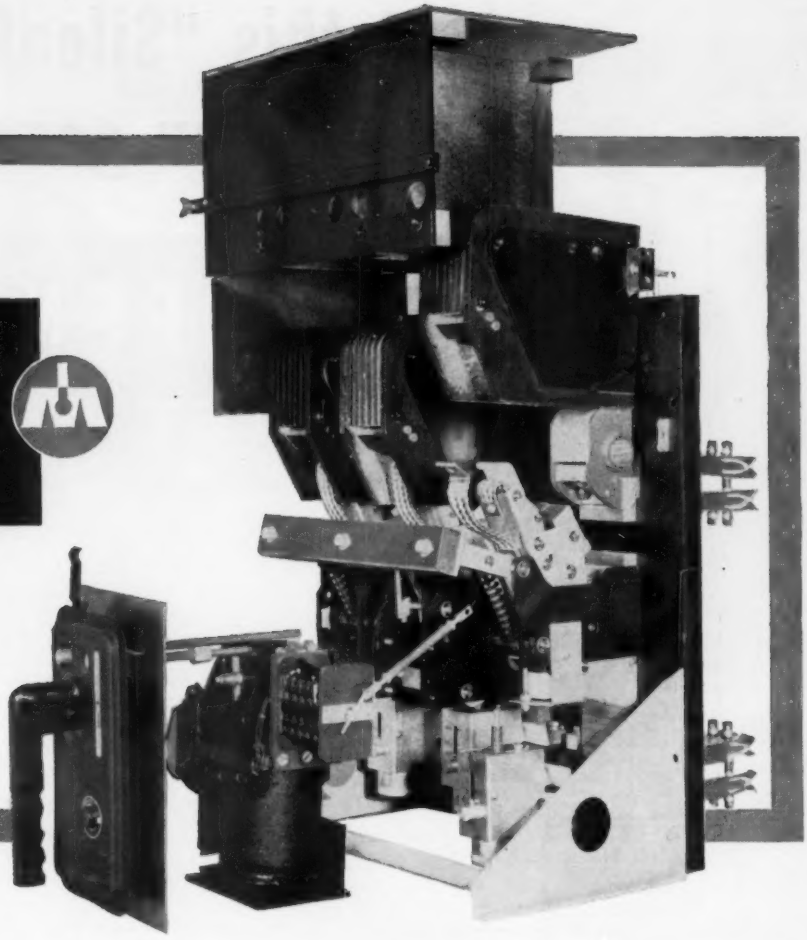
Yet with all these operating and installation "plusses," Touchette is the *least expensive touch switch* on the market.

Could any touch-action switch possibly offer more?

Sold only through electrical wholesalers.
Or for further information and prices,
write Rodale direct.

Rodale / manufacturing co., inc.
dept. C2 emmaus, pa.

MEARS
LOW VOLTAGE
AIR CIRCUIT BREAKERS



A circuit breaker must be 100% dependable

(or it is 100% worthless)

The dependability of a circuit breaker is something unique. It is built to handle a crisis that may never occur. Unable to flex its muscles regularly, its function is to rest in a state of inactive readiness for years on end. If it fails once it is a *total* failure.

There are two ways to check a circuit breaker's dependability. One is to assess its mechanical design in the light of an engineer's basic knowledge of electromotive and mechanical forces. Another is to look at the record. On both counts Mears invites the most searching inquiry. Many exclusive design features provide an exceptional margin of safety. As for the record—no Mears circuit breaker has ever failed, even after years of suffusion in the abrasive dust of cement mills or the corrosive fumes of chemical plants.

It will pay you to learn more about Mears low voltage air circuit breakers.

Mears circuit breaker features

- . . . Both electrical and manual operation.
- . . . Low operating temperature.
- . . . Sintered silver contacts.
- . . . Shockproof.
- . . . Vertical plane design.
- . . . Dustproof.
- . . . Operating torque with 300% safety margin.
- . . . Light tripping action.
- . . . Low maintenance.
- . . . Extra wide range of ratings (can be sized to job).
- . . . Only West Coast breaker manufacturer.
- . . . Fast Delivery.
- . . . Up to 75,000 Amp interrupting capacity.

MEARS
AIR CIRCUIT BREAKERS

Artwell Electric—San Francisco, California
F. M. Ballow, P. E. Co.—Ridgewood, N. J.
Charles E. Colbert, Cleveland, Ohio
Electrical Jobbers Equipment Co., Minneapolis, Minnesota
L. H. Jones Company, Emmaus, Pa.
James P. Laughlin, Detroit 35, Michigan
Roy Peck Associates, Arcadia, Calif.
Slaybaugh-Thompson Co. — Denver, Colorado
L. L. Weidy & Associates, Inc.—Chicago, Ill.
M. H. Gottfried, Mexico City
H. G. Lehl, Portland, Oregon

Send today for catalog and test information

Mears Electric Circuit Breakers, Inc.
Swan Island, Portland 17, Oregon

Please send me "Mears Low Voltage Circuit Breakers" catalog:

Name_____
Firm_____
Address_____
City_____ Zone____ State_____

Let this "Silent Salesman" help you get more jobs

SPECIFICATION GRADE

CIRCLE F NO-KLIK® QUIET SWITCH

Circle F NO-KLIK Quiet Switches clinch many a job for the electrical contractor. It's amazing what an enthusiastic response you can get merely by handing one to a prospective customer and letting him flick it on and off a few times. Everybody wants it, once they discover what a contrast there is between its quiet, smooth operation and the sharp click of the ordinary switch.

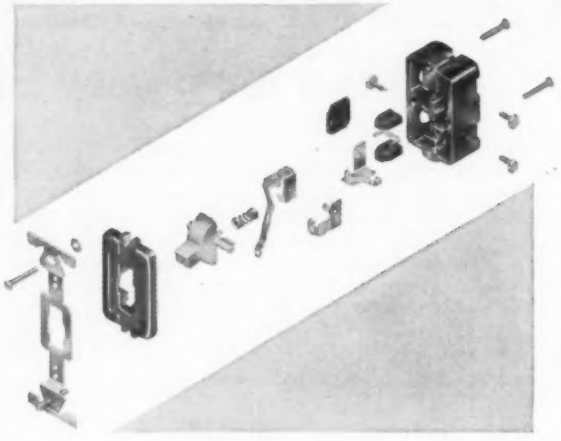
The NO-KLIK Switch is a natural for bedrooms, nurseries, libraries, hospitals, offices, hotels—wherever quiet is desirable. Many home-owners want them for all rooms. Let Circle F NO-KLIK Quiet Switches help you land more jobs—and satisfied customers. See your distributor, or write us direct.

Simple, compact mechanical design — no mercury or fluids

Exploded view shows simplified construction . . . silver contacts for smooth, reliable, lifetime switching action . . . operates in any position . . . totally enclosed mechanism has #8 binding screws to take wire up to No. 10.

15 Amp., 120 Volts, A-C only [L]	20 Amp., 120 Volts, A-C only [L]
15 Amp., 120-277 Volts, A-C only	20 Amp., 120-277 Volts, A-C only
#3401 S.P. Brown	#3421 S.P. Brown
#3401-I S.P. Ivory	#3421-I S.P. Ivory
#3402 D.P. Brown	#3422 D.P. Brown
#3402-I D.P. Ivory	#3422-I D.P. Ivory
#3403 3-way Brown	#3423 3-way Brown
#3403-I 3-way Ivory	#3423-I 3-way Ivory
#3404 4-way Brown	#3424 4-way Brown
#3404-I 4-way Ivory	#3424-I 4-way Ivory

Approved for control of Fluorescent Lamps on A-C circuits of 277 Volts and less and for motor loads up to 277 Volts at 80% of current rating of the switch.



Circle F Mfg. Co.

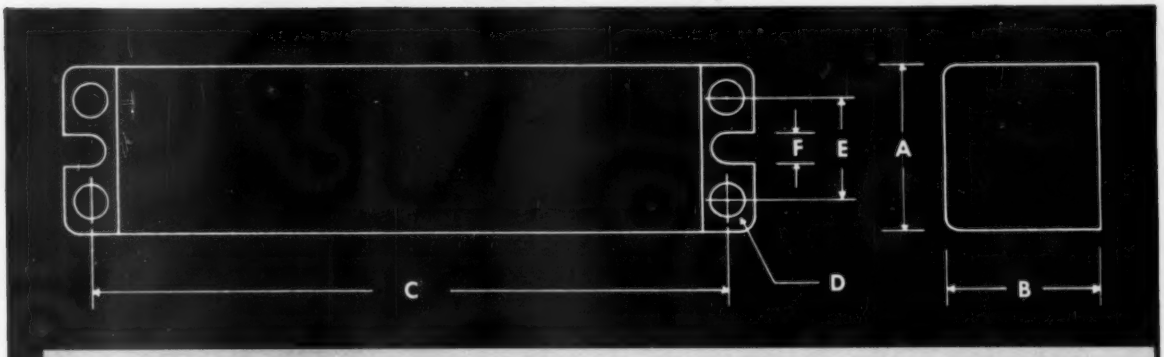
TRENTON 4, NEW JERSEY

IN CANADA: VERD-A-RAY ELECTRIC PRODUCTS LTD., MONTREAL 9.

For your wire requirements: Eastern Insulated Wire Corp. (A Subsidiary), Box 591, Trenton, N. J.

HOW CBM ASSURES YOU BETTER BALLAST VALUE

New recommended standards for ballast cross section and mounting dimensions aid fixture designers, architects, engineers, add flexibility for purchasing and replacement.



	DIMENSIONS (INCHES)														
	(MAXIMUM) CROSS SECTION		LENGTH (NOMINAL)											CORNER MTG. HOLES		CENTER (MAX.) MTG. SLOT
	A (WIDTH)	B (HEIGHT)	C (MOUNTING)											D (DIA.)	E (WIDTH)	F (WIDTH)
1	2-3/8	1-11/16	6	7-13/16	8-57/64	9-17/32	11-1/4			14-7/16	15-7/16			15/64 or 7/32	1-11/16	5/16*
2	2-13/16	2			8-57/64		11-1/8		13-3/4					15/64 or 7/32	2	5/16
3	3-1/8	1-25/32			8-57/64		11-9/64		13-3/4					15/64 or 7/32	2	5/16
4	3-3/16	2-3/8			8-57/64		11-9/64		13-3/4				18-5/8	15/64 or 7/32	2	5/16
5	3-3/16	2-5/8			8-57/64		11-9/64	13	13-3/4		15-5/8	16-1/8	18-5/8	15/64 or 7/32	2	5/16

**Drawn cases use center slot only for mounting.*

HERE'S an example of CBM at work to give the fluorescent lighting industry better ballast value. As the result of a study by one of the technical committees of the Certified Ballast Manufacturers Association . . .

22 different cross section dimensions for ballasts were cut to 5;

35 different mounting lengths were reduced to 14.

Obviously, this offers practical advantages to fixture manufacturers and engineers in the design of new units—and makes for a wider choice of component sources.

But this is over and above the basic contribution of CBM—the specification that assures quality performance from ballasts . . . including high light output, long lamp life, high power factor, long life service . . . with conformance checked and certified by Electrical Testing Laboratories. And of course, Certified CBM Ballasts are UL listed!

Learn why Certified CBM Ballasts serve you better . . . why it pays to specify fluorescent fixtures equipped with CBM Ballasts as their control center. Write for: *How to Insure Your Lighting Investment.*

Chairman of CBM Technical Committee on study of ballast case dimensions discusses a point with a colleague . . . one of many sessions.

CBM CERTIFIED by ETL

C ERTIFIED
B ALLAST
M ANUFACTURERS

2118 KEITH BUILDING
CLEVELAND 15, OHIO

Participation in CBM is open to any manufacturer who wishes to qualify

Broan set out to design a *far better* Ceiling Heater and Light Combination and here it is—the *Broan Leader*

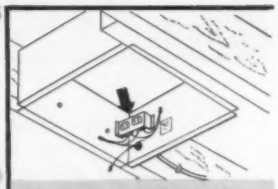
It's even a leader in price

You'll see many points of superiority in this new Broan fixture:

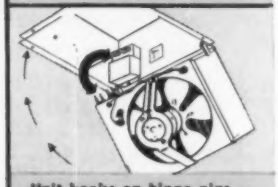
1. Abundant heat — 1500 watts — 5000 BTU. Propels a gentle, diffused stream of warm air downward over a wide area. *NOT* a drafty jet stream from a high-velocity blower.
2. Greatly improved illumination — 120 watts of intensified, glare-free lighting, flooding from a large, prismatic crystal lens — not frosted glass.
3. Stainless steel grille with lifetime mirror finish — unaffected by bathroom moisture.
4. Easiest fixture of all to install. Electrician completes all field connections in outlet box in housing when roughing in. No other electrical work. Unit installs later — swings into place — plugs in automatically. No trailing wires.
5. Safe — thermal overload protected.
6. Compact design. Fits between 6" joists. 11½" square housing; 13½" square grille gives ample overlap. A single, economical installation for both heat and light. Vibration-free housing.
7. Costs less than other units and costs less to install. 5-year guarantee.

No. HL-15

Fast, EASY Installation



Field connections are completed when housing is installed. No further electrical work.



Unit hooks on hinge pins — swings up — plugs in automatically.

A single thumb screw fastens lens and grille securely.

See your wholesaler or write for information.

Broan MANUFACTURING CO., INC.

948 West State St., Hartford, Wis. (*Near Milwaukee*)

Specialists in Quality Ventilating Equipment for More than 25 Years

Identical Twin Unit In Ventilating Fan and Light No. 610

This unit exactly matches the Ceiling Heater and Light; teams beautifully with it to make an outstanding twin light installation. Alone, it provides a luxury touch at a budget price. Has the same stainless steel grille as the twin unit, with air intake all around. Backdraft damper fits snugly against resilient gasket. Economical — one installation serves a double-purpose fixture. Uses 3" round duct. Single or double switch; fan time-switch available. Five-year guarantee.

No plastic electrical tape resists flame like SCOTCH No. 33!

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NATIONAL ELECTRICAL WEEK
FEB. 8-14, 1959

"SCOTCH" Brand No. 33 Electrical Tape has a greater resistance to burning than any other plastic tape! And remember, only the genuine "SCOTCH" No. 33—*invented* as a new type of wire splice covering—has "Scotty's" plaid on the can and "No. 33" inside the red core. Ask your distributor about the full line of "SCOTCH" Brand splicing materials, or write us for complete information.

"SCOTCH" and the plaid design are registered trademarks of Minnesota Mining and Manufacturing Co., St. Paul 6, Minn.

The price per splice is less!

Let us prove it!

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All right!—*show* me! Send someone around to prove that the price per splice of "SCOTCH" No. 33 is less!

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...WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

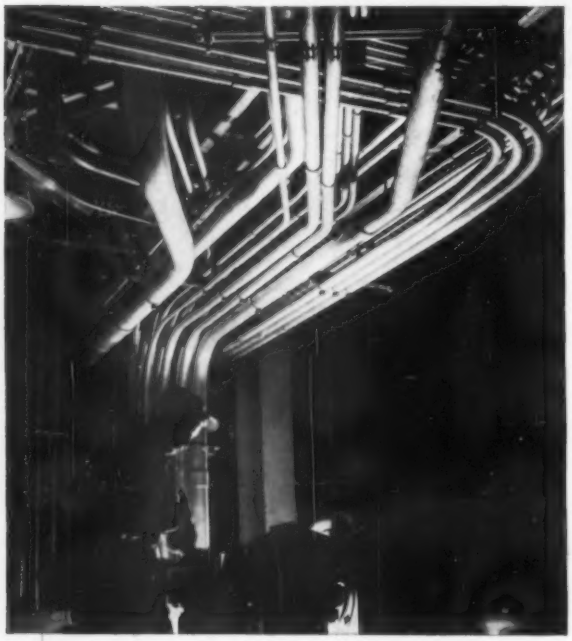
LIGHTWEIGHT KAISER ALUMINUM RIGID CONDUIT reduces handling and installation costs

WEIGHT COMPARISON, ALUMINUM VS. STEEL

U.L. required minimum weight per 100 ft. including couplings, lbs.

Trade Size, Inches	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6
ALUMINUM	27.4	36.4	53.0	69.6	86.2	115.7	182.5	238.9	287.7	340.0	465.4	612.9
STEEL	79.0	105.0	153.0	201.0	249.0	334.0	527.0	690.0	831.0	982.0	1334.0	1771.0

This chart shows 66% reductions in the weight of aluminum conduit as compared to steel conduit. Result: easier handling, reduction in worker fatigue, lower labor costs.



CHECK the chart . . . aluminum conduit weighs only *one-third as much* as steel conduit!

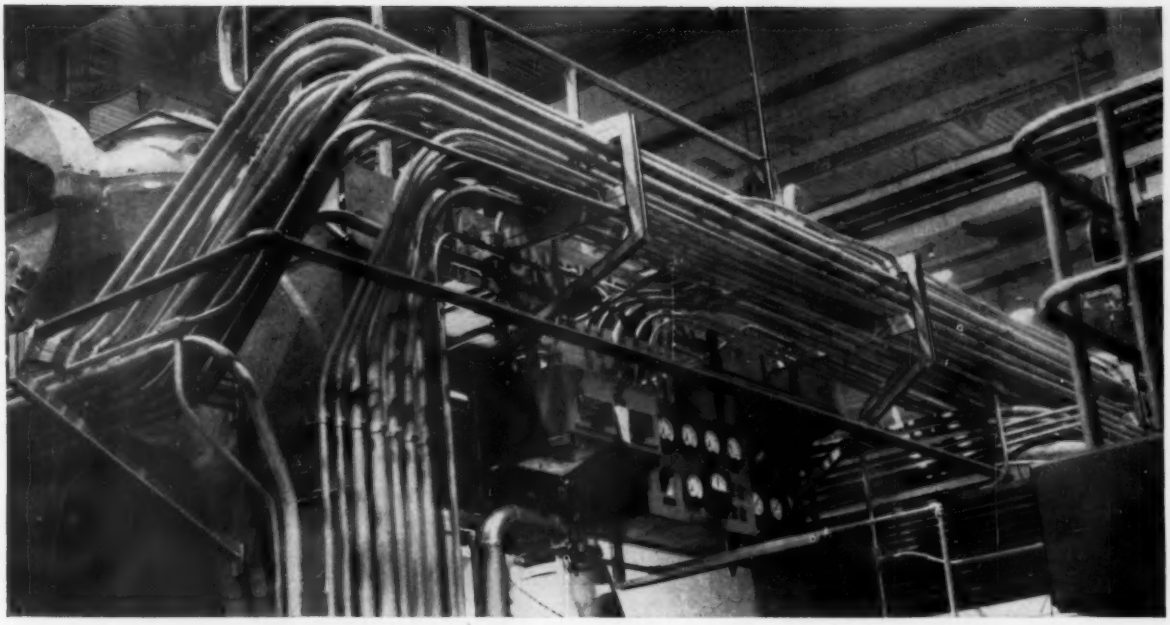
This lighter weight pays off in faster installation with less worker fatigue. Result: lower installation costs . . . with savings up to 50% in some cases!

And here's another cost-saver: lightweight aluminum conduit requires fewer hangers or supports. For large cable-conduit feeders in sizable groups or banks, the number of supports can be greatly reduced. Definite labor savings can be made, especially where supports must be installed in masonry with star drills.

Aluminum conduit's lighter weight pays off in lower handling costs too. For example, standard 10-foot lengths of ¾" steel conduit, usually delivered in groups of five, weigh 53 pounds delivered. Similar aluminum conduit, *delivered in groups of ten*, weighs only 37 pounds.

Corrosion Resistant To Cut Maintenance Costs

The excellent resistance of aluminum to atmospheric



and chemical corrosion has been proved by numerous and extended exposure and laboratory tests, and by countless applications in the process industries.

Aluminum's ability to resist corrosion means that maintenance is virtually eliminated. No painting is needed. Replacement costs are held to an absolute minimum.

And, since aluminum can't rust, cost economies can also be realized in storage. No special storage preparations are necessary.

Nonmagnetic To Reduce Voltage Drop

Because aluminum conduit is nonmagnetic, it is not subject to magnetically-induced energy losses.

This reduction of energy loss permits a longer run of cable without exceeding the voltage drop as specified in the National Electrical Code. In some installations this will permit the use of a smaller size conductor and conduit.

A further advantage is that each conductor in either a single-phase or polyphase system can be enclosed in a separate aluminum conduit, regardless of electrical load. Separate rigid conduits greatly simplify installation of electrical equipment having widely spaced terminals. Terminal overcrowding is eliminated.

Get ALL The Facts Now!

We will be glad to send you an informative 9-page magazine article entitled "Now We Can Specify Aluminum Conduit."

This article contains a complete run-down on the advantages of using aluminum conduit—comparative conduit weights, comparative labor cost charts, installation facts, and much more valuable information.

We'll also send our *Aluminum Rigid Conduit* brochure, with installation data, specifications and availabilities for Kaiser Aluminum rigid conduit.

Get *all* the facts about aluminum rigid conduit and how it can save you money. Mail the coupon now!

KAISER ALUMINUM

IF IT CARRIES CURRENT, K&W CARRIES IT!

See Aluminum Conduit featured on "Maverick", Sunday evening, March 15, ABC-TV Network.

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58TH YEAR • FEBRUARY 1959

ELECTRICAL CONSTRUCTION AND MAINTENANCE

New Lighting Standards

In April last year we discussed on this page a break-through in the basis for illumination application practice. The results of an eight-year research project under the direction of Dr. H. R. Blackwell at the University of Michigan and sponsored by the Illuminating Engineering Society were reported at about that time.

Interpretation of the research results by the various technical committees of IES subsequently led to major changes in the minimum footcandle intensities recommended by the Society. The research and the resulting new lighting recommendations have been the subjects of extensive industry discussion in recent months. And many more meetings will have to be devoted to exploring this sudden and, in some ways, spectacular step forward in lighting application design.

Slow acceptance in the field of the new standards has been, to some, discouraging. Actually it is remarkable that they have met so little unfavorable reaction. The timing was most unfortunate. Design and application practices costing twice as much as those previously identified as acceptable were proposed during what happened to be the middle of a year of recession and retrenchment or just about the worst possible climate for an engineering development of such importance.

Fortunately the economy has turned upwards and those responsible for laying out the funds for construction and modernization are now more willing to listen to engineering proposals representing the best knowledge of our time. The costlier new lighting and electrical systems required to meet the scientifically based IES recommendations should encounter no more than usual inertia from now on.

But sudden popular acceptance is not likely. The new standards are in many instances equal to or better than the upper brackets of current practice. They are bound to encounter some buyer resistance on the basis of cost. And there is still comparatively little public experience with high-level, well-engineered installations. Since the new standards are built on hard objective research, however, their ultimate acceptance is only a matter of time, education and industry effort.

At the present time the primary industry objective is, obviously, to install systems which provide illumination at or above the recommended levels in footcandles. But this objective is only a part of the broad challenge of the Blackwell research. The up-grading of intensity must be coordinated with improvements in control, in brightness ratios and in the elimination of glare. The true measure of good lighting is, ultimately, what the eye perceives; comfortably, quickly, and accurately.

Wm. T. Stuart

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POWER DISTRIBUTION

proper planning saves future costs

Your customer is building a new plant or planning to expand present facilities. You want to install an electrical system that will satisfy today's needs yet provide the greatest flexibility for future growth. Calling Graybar is the easiest way to avoid electrical obsolescence, costly rewiring, and plant engineering problems at a later date.

A Graybar Inside Construction Specialist will review the requirements with you and your customer. From broad experience he can suggest new methods and recommend modern wiring techniques. He can advise in the selection of the latest products available and help determine a power-distribution system that will serve present, near-future and long-range expansion demands.

Over 130 Graybar locations are ready to serve you with complete catalog and quotation information to help you work out job costs and specifications — for lighting, power, control, ventilation, communications as well as wiring.

674

An enclosed bus system is today's most efficient method of electrical distribution. Its flexibility and economy are fully explained in this illustrated booklet. If you are located in the U. S., or its possessions, write us for your free copy.

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ELECTRICAL CONSTRUCTION AND MAINTENANCE

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Textbook Distribution

College laboratory building uses electrical system as educational medium; a wide variety of equipment and installation methods demonstrate features of electrical capacity, flexibility, switching, control, safety and continuity for the information of fact-seeking engineering undergraduates.

By Albert A. Richman,
President, Lightning Electric Service Co.
Newark, N. J.

STEVENS Institute of Technology in Hoboken, N. J., has a new 7-floor multi-purpose laboratory building containing comprehensive facilities for electrical, physical and metallurgical instruction and research. Equally multi-purpose is the structure's electrical distribution system that offers dozens of "plus values" related to power capacity, flexibility, safety, variety, switching and control. This, in turn, adds up to still another value because, due to the order of craftsmanship with which system components are installed and identified, the electrical facilities constitute an "open textbook" of progressive design and wiring methods for undergraduate engineers-of-the-future to study and analyze.

The system's wide variety of distribution and control equipment was dictated by two precepts.

First, it became functionally necessary in view of the fact that the building contains space allocations ranging from conventional classrooms, conference and seminar halls, offices, libraries, a lecture theatre, kitchen and lobby . . . to laboratories devoted to measurements and electronics, servomechanisms and automation control, advanced communications and mechanical testing, fatigue and thermal research, X-ray and diffraction, photo and electron microscopy, metallurgy and metalography, chemical and electrochemical work, atomic physics and special graduate projects.

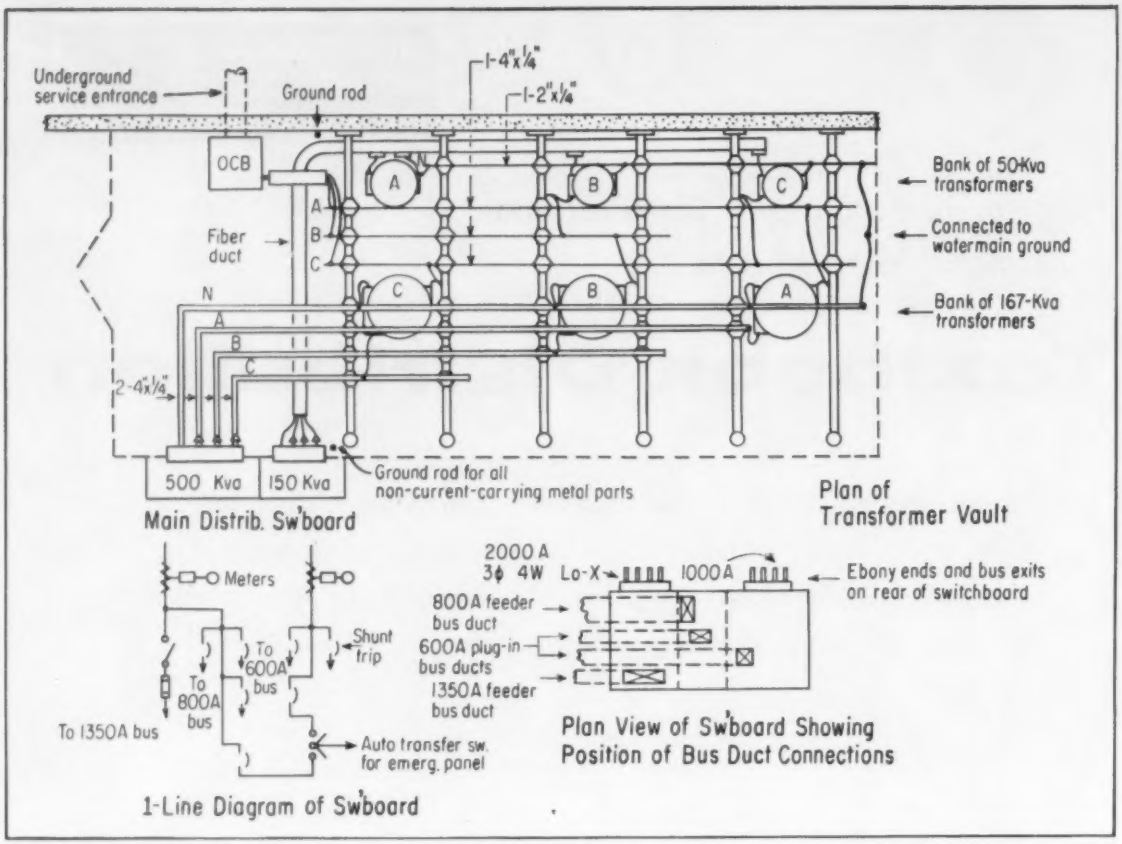
This variety of space allocation resulted in an equally varied scope of power demands, inasmuch as the assortment of instruction rooms, shops and laboratories required such items as projection and sound equipment, special lighting, power saws and shears, welders, grinders and belt sanders, lathes and drill presses, milling machines and core-winding rigs, special transformers and m-g sets, motors (induction, compound and shunt), electric furnaces (convection, induction and tubular), salt pots and cutoff wheels, impact machines and hardness testers, rolling mills and tensile machines (producing stresses up to 60,000 psi), compressors and high-frequency generators.

Add to this the fact that electrical requirements included both dc and ac, 400- as well as 60-cycle current, multi-step and variable voltages, and one obtains a rough approximation of the electrical variety related directly to curricular activities.

The second design precept, however, contributed even more extensively to the system's variety, since (as a recognized educational potential) the system was planned and installed to offer such "open textbook" values as comparison, exposition and definition of equipment and distribution methods.

As a result, electrical students can note the application of both liquid-filled and air-cooled transformers, low-reactance feeders as well as plug-in busducts, aluminum as well as copper bus structures, different types of cable and insulation recommended for different applications, rigid as well as flexible conduit, various methods for support and suspension, several grounding methods, the use of motor control centers as well as local switchgear, breakers as well as fuses, ad infinitum.

In addition, electrical components are plainly identified by color-coding, mimic bus diagrams



GROUNDED WYE 4160/2400-volt primary service is transformed to utilization level of 120/208-volt via two banks of single-phase transformers, a 150-kva bank exclusively serving a section of the main distribution switchboard related to electrical engineering applications, and a 500-kva bank serving all other building demands.

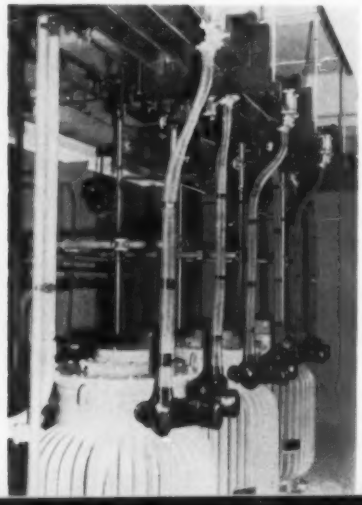
on switchgear enclosures, nameplates to identify switches and monitoring instruments, tags and decals in all pullboxes and panel gutters. Components are also effectively "displayed" by the use of accent painting and ample illumination—even the transformer vault being lighted to an average intensity of 60 footcandles by continuous rows of semi-direct fluorescent luminaires.

And, speaking of the transformer vault, students can safely observe the internal action of items such as circuit breakers—by looking through specially installed shatterproof glass panels set in the front and sides of interior-lighted metalclad housings enclosing unit switchgear.

Quality of workmanship was likewise stressed in this installation—the result being a precision code-surpassing job that merits recognition for many carefully executed recommended procedures.

TEMPERED GLASS viewing ports in front and side panels of main oil circuit breaker permit engineering students to safely observe internal action of unit. Illumination for inspection purposes is provided by incandescent lamps located inside metalclad enclosure.

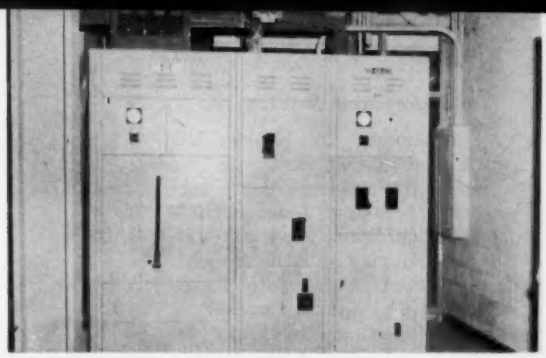
FUSE CUTOUTS for each phase leg of each transformer, 4-wire primary bus system and two secondary feeders with full-sized neutrals are supported above back-to-back transformer banks on clamped-pipe structure. Ample space is provided for expansion.



Vault Variety

Power for the new lab building is provided by a 4160/2400-volt 3-phase 4-wire grounded-wye service, said service being supplied to the lab's primary OCB via rubber-insulated corona-resisting neoprene-jacketed 5-kv conductors that are brought through underground conduit from the college's central switching vault (located in an adjacent building). As previously indicated, the main OCB is internally lighted and equipped with glass viewing ports to permit

BUSBARS AND H-CLAMP connections are left bare when position of same is normally inaccessible, thereby permitting students to study installation details more clearly. Where bus structure is dropped to lower level to enter rear of main switchboard, however, buses are double-wrapped with electrical tope for protective purposes.



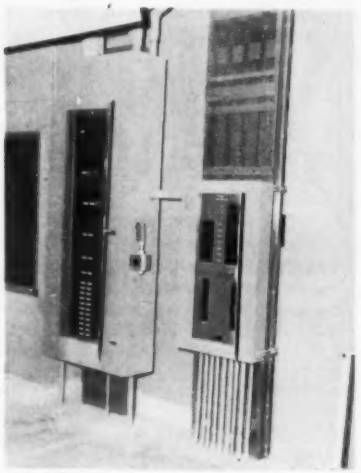
BOLTED PRESSURE SWITCH with mechanical lock to hold switch closed against mechanical stresses of short circuits (left) is related to 1350-amp busduct feeder serving upper floors of laboratory building. Although 500-kva building and 150-kva EE sections of the main board normally operate independently, either section may be used for emergency.

student observation of breaker action.

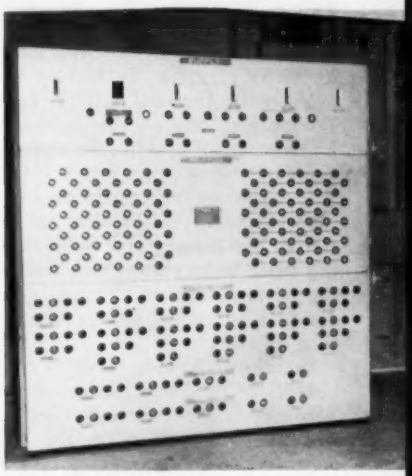
Within the main vault of the laboratory building are two banks of single-phase non-flammable non-explosive askarel-filled transformers that step current to the general utilization level of 120/208 volts. One bank of three 50-kva units provides power to a 150-kva section of the main switchboard for exclusive electrical engineering applications, while the second bank (consisting of units rated normally at 167-kva each) separately serves all other electrical needs in the building through a 500-kva section of the same switchboard assembly.

These two transformer banks are set back-to-back beneath a common clamped-pipe structure that supports a 4-wire primary bus system (consisting of solid 2/0 5-kw AVA on 7½-kv skirt insulators), fuse cutouts for each phase leg of each transformer, plus two secondary feeders (having full-sized neutrals) that extend overhead to the main switchboard.

One of these overhead secondary feeder installations (as well as the primary) consists of copper bars supported in ebony-asbestos bus-mounting blocks, splices being made by silver-plated offset overlapping leaves and H-clamps. Connections between this bus structure and the 167-kva transformers are by means of AVA cables and additional clamps, although in this instance connections are *not* silver plated, thereby demonstrating the use of another accepted distribution practice. Connections (located some 10 ft above the floor level and therefore normally inaccessible) are left bare in order to more clearly show connection, splice, mounting and silver-plating details to students. However, where the bus structure is offset and dropped to a lower level in order to enter the rear of the main switchboard, buses are double-wrapped with Scotch electrical tape for protective reasons.



ALUMINUM LOW-REACTANCE busduct structures serving upper floors consist of individually wrapped bars in expanded-metal enclosures. Distribution panelboards on each floor were designed and installed as integral parts of the riser systems. Full-capacity taps installed ahead of main breakers in all distribution panelboards make it possible to provide total power potential to any floor or for any special purpose for short periods, if so required.



FREE-STANDING switchboard related exclusively to laboratory requirements contains circuit breakers, jacks, pushbuttons and instruments necessary to distribute, interconnect and measure 125/250-volt dc; 6-, 30- and variable-voltage dc, also 400- as well as 60-cycle 120-volt ac. Boards on various floors vary in width from 3 to 8 ft; are accessible from both front and rear; are clearly identified through the use of distinctive colors, engraved nameplates and mimic bus diagrams.

The other secondary feeder (connecting the three 50-kva transformers with the EE section of the board) utilizes cables carried in fiber conduit (rather than busbars) in order to illustrate an alternative method for accomplishing this transmission.

Due to the nature of the building's educational application, noise-suppression was considered as another design precept. Therefore transformers are low-decibel units, mounted on vibration pads to minimize hum and to segregate 60-cycle pulsations from the structure of the building.

Transformer frames are paired through the installation of copper grounding straps which are mutually connected via bare stranded cabling to driven copperweld ground rods. This same grounding system is tied to all non-current-carrying electrical components in the vault, while a second grounding system (tied to the street side of the cold water main valve) is utilized for connecting system neutrals to ground.

Segregated Service

As mentioned, the 150-kva EE section and the 500-kva building section of the main board are segregated, operating independently under normal conditions, although either section may be used (through the medium of an automatic transfer switch and flanking breakers) should it become necessary to power an emergency panel for the lighting of stairways, halls and critical lab areas.

On the 500-kva side of the board, one of the branch circuits (a 1350-amp feeder) is protected by an externally operated bolted pressure switch equipped with mechanical lock to hold the switch closed against mechanical stresses set up by short circuits. It is also provided with current-limiting fuses. Feeder breakers on this side have interchangeable trip elements of non-fixed types.

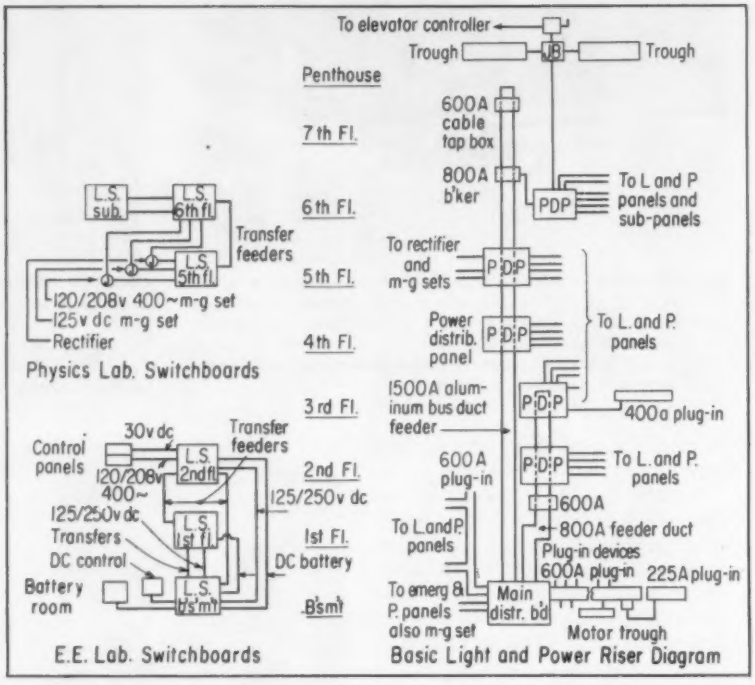
It is also of interest to note that the emergency tie breaker on this side of the board has current-limiting fuses to increase the IC. Opening of any fuse or any phase leg, due to overcurrent, will in turn trip this breaker.

On the EE side of the main board, one subfeeder is related to a busduct riser serving general power requirements in EE labs only, while a second subfeeder (equipped with a shunt trip) provides ac power for EE lab patchboards and an m-g set that, in turn, furnishes labs with dc.

The output side of the generator is likewise provided with a shunt trip, both of these trips commonly controlled so that all power related to patchboards (both ac and dc) will be interrupted simultaneously.

The board as a whole is a totally-enclosed metal-clad free-standing assembly, main feeders from transformers entering the rear of the board via bus extensions and ebony end plates, and sub-feeders for general power and lab service leaving the board from the top.

These building feeders include four 4-wire full-neutral main bus structures, one of which is a 1350-amp aluminum low-reactance installation (with individually wrapped bars contained in an expanded-metal enclosure). This busduct extends to power distribution panelboards on the 5th and 6th floors, also to penthouse-based wiring troughs related to ventilation

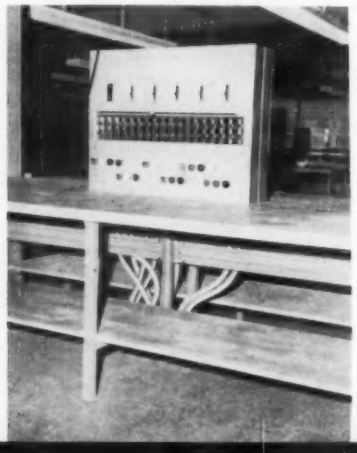


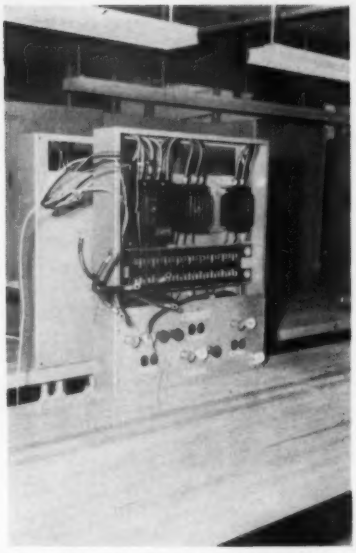
BASIC LIGHT AND POWER system and distribution facilities related to laboratory requirements exclusively are completely separated. As indicated, lab switchboards are grouped into two major systems that collectively supply over 90 local service stations with a wide variety of electrical services.

LABORATORY SWITCHBOARD located in basement is connected to counterparts on first and second floors by means of transfer feeders, dc battery and 125/250-volt dc circuitry. Pin-type receptacles are used when it is necessary to insert mating parts to make connection "hot", while socket-type receptacles are used in cases where receptacles are hot regardless of parts being inserted.

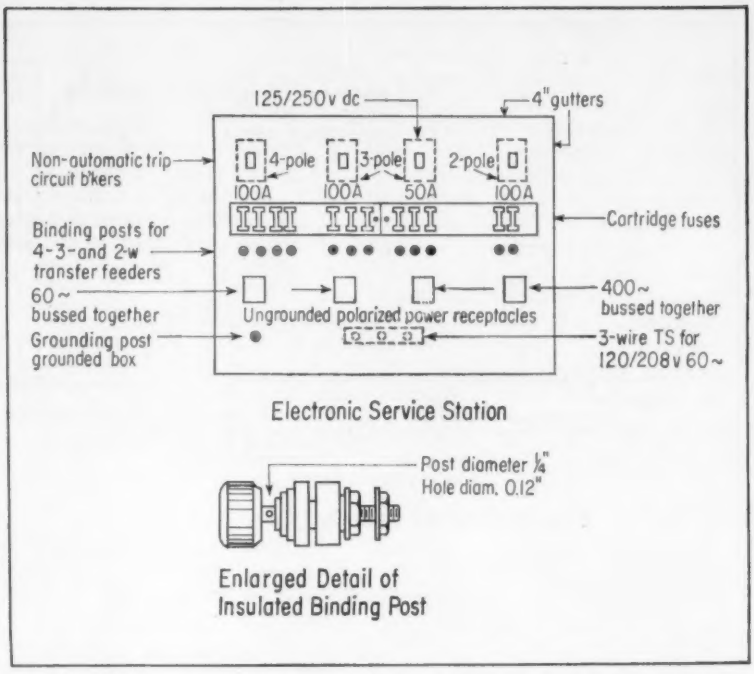
INCOMING CONDUITS related to laboratory switchboards are stubbed up through floor slabs and are bonded together via bare copper grounding wires and clamps as shown. Bussing of board is with hard-drawn copper, while both incoming and outgoing power connections are effected through solderless lugs.

LOCAL LABORATORY SERVICE STATIONS vary considerably in size and design, depending upon their location and specific purpose, although most of them include 2-, 3- and 4-wire transfer facilities, cartridge fuse blocks, and related breakers, receptacles and grounding provisions.





TYPICAL LOCAL LAB STATION with cover removed shows arrangement and gutter space around non-automatic circuit breakers and 2-, 3- and 4-pole cartridge fuse blocks. Receptacles related to various voltage and frequency levels are polarized, single or double, grounded or ungrounded. Individual stations vary with needs of areas.



ARRANGEMENT OF EQUIPMENT on medium-sized lab station also assumes above-illustrated positioning. Details of insulated binding posts related to transfer feeders are indicated by the enlarged sketch.

and elevator equipment. An expansion joint is located at the 4th floor slab level, while all intervening slabs are provided with full flange supports and fire stops.

A second busduct feeder consists of an 800-amp aluminum low-reactance assembly serving middle-floor power panelboards through tap boxes, and also serving a 400-amp half-neutral plug-in bus sub-section located in a melting hot-work lab.

The third feeder takes the form of a 600-amp plug-in copper busduct (extending upward from the 150-kva EE section of the basement board) that serves the first two floors of the building, while a fourth riser consists of a similar 600-amp plug-in run through the basement, with extensions of cable in conduit (connected through plug-in breaker elements) to serve (1) a sub-section of 225-amp plug-in 4-wire half-neutral copper busduct installation located in a metallurgy shop, (2) a wiring trough for motor applications in a basement mechanical room, (3) a 125/250-volt dc m-g set, and several basement and first-floor power panels.

Since it is possible (for short periods or for special projects) for the full capacity of any one (or more) busduct feeders to be required on any floor of the building, it is interesting to note that this capacity may be provided through full-capacity taps that are installed ahead of main breakers in all power distribution panelboards. In several instances there are also auxiliary tap boxes installed on some risers that do not (normally) serve the floors where such taps occur. In all instances, distribution panelboards (on each floor) were designed and installed as integral parts of the bus riser systems.

Laboratory Components

In addition to the electrical distribution system serving normal and lighting loads, a second distribution system is related exclusively to laboratory requirements.

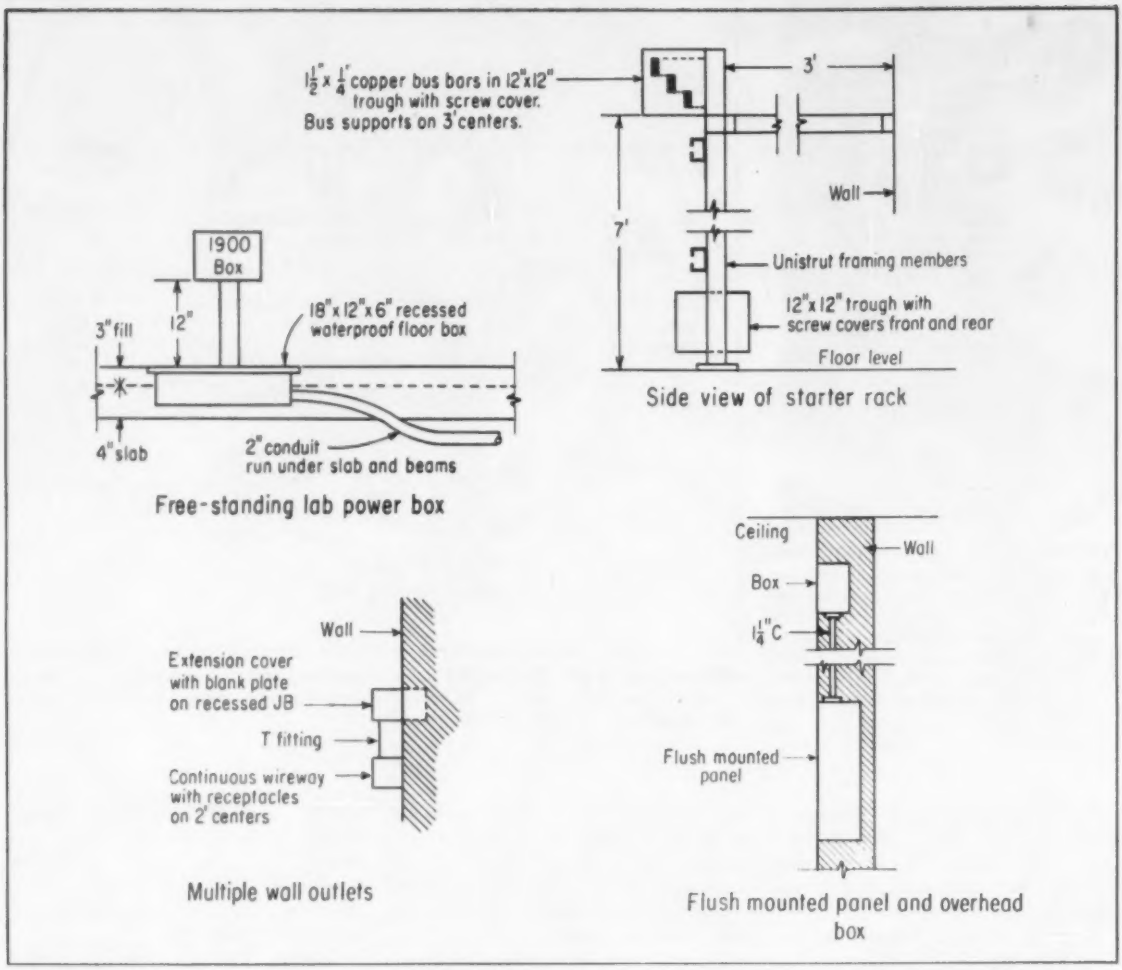
This second system consists of a series of supply and distribution switchboards, service stations, jack-plug patch panels, plus necessary connections between these various elements as well as between related control panels and auxiliary service facilities.

Main switchboards in this installation are free-standing assemblies 7-ft in height and varying between 3 and 8 ft in width. Boards, constructed of furniture-grade sheet steel, are front-and-rear-access units, backs of boards being protected by wire-mesh enclosures equipped with normally locked doors to preclude tampering by unauthorized persons.

These boards contain circuit breakers, jacks, pushbuttons and instruments necessary to distribute, interconnect and measure 125/250-volt dc; 6-, 30- and variable-voltage dc; and 400- and 60-cycle 120-volt ac.

In construction, incoming conduits are stubbed up through floor slabs into the rear of switchboard panels; bussing is via hard-drawn copper; both incoming and outgoing power connections are made with solderless lugs; engraved identification nameplates are formed from white-core laminated plates; mimic bus diagrams on panel fronts indicate bussed and common connections; fuses are clearly identified and rear-mounted to permit ready access; and all receptacles and binding posts are color-coded, green designating grounding and white identifying neutrals on all common-bussed receptacles.

Hot receptacles (that is, live without the necessity of mating parts) are socket-type, while cold



DISTRIBUTION of "standard" power is accomplished by means of such items as recessed waterproof floor boxes, elevated free-standing receptacle boxes on conduit stubs, conduits run in or beneath slabs, semi-recessed or flush wireways on lab walls, recessed panels and boxes, also special starter racks as indicated above.

receptacles (which are live only after mating parts are inserted) are pin-types. Both hot and cold receptacles having 250-amp ratings are unfused, although 100-amp receptacles are fused. All current-carrying parts of 250-amp jacks and plugs are also silver-plated, while plugs and jacks having the same capacities are identical and interchangeable.

Patch connections between switchboard receptacles are established by means of neoprene-jacketed flexible cords having mating plugs for both pin and socket receptacles. Cords (7 ft long for the basement board and 4 ft for boards located in upper-floor laboratories) are stored at each switchboard location on wall racks, cords being provided in quantities sufficient to connect all facilities on all boards simultaneously.

Circuit breakers installed on these boards are of three types: J-frames being used for capacities above 100 amps, F-frames for 4-pole non-automatic operation at 100 amps and below, and E-frames used for single- and 3-pole non-automatic operation where ratings are below 100 amps.

These laboratory switchboards are classified into two groups, the first group (pertaining exclusively to electrical engineering facilities) including boards in the basement and on the first two floors of the building, the second group (serving physics labs exclusively) including boards on the 5th and 6th floors.

As indicated by an accompanying diagram, the basement board is connected to its two related counterparts by separate 8-wire dc battery and 3-wire 125/250-volt dc circuiting, while the three boards may also be interconnected by means of additional 2-, 3- and 4-wire transfer feeders. It will also be noted that the basement board is directly connected to a battery room and to a 125/250-volt dc control panel, while the upper (2nd-floor) board connects to control panels related to 30-volt dc and 120/208-volt 400-cycle ac service.

Similar interconnections are also possible between boards on the 5th and 6th floors. These boards are connected separately to a 10-kw rectifier and to 125-volt dc and 120/208-volt 400-cycle motor-generator sets, and are interconnected to each other through additional 2- and 3-wire transfer feeders.

Collectively, these main laboratory switchboards make it possible to supply a variety of electrical

services to over 90 local service stations located throughout the building.

As would be expected, local service stations vary considerably in design depending upon specific location and purpose. However, in various combinations, they include 2-, 3- and 4-wire transfer feeder facilities; 2-, 3- and 4-pole cartridge fuse blocks; non-automatic circuit breakers; polarized, grounded and ungrounded single- or duplex-receptacles pertaining to various voltage and frequency levels; grounding provisions; and an array of variously rated switches and insulated binding posts.

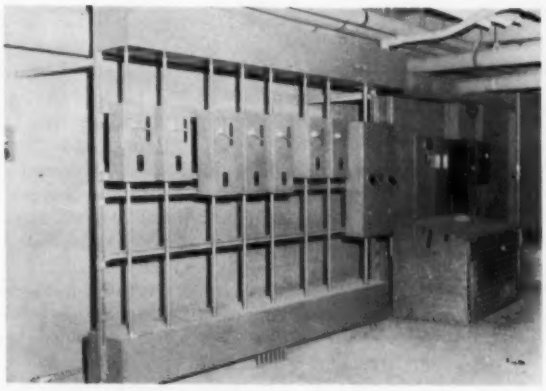
Additional service stations in local laboratory areas (related to "standard" frequency and voltage levels) also take the forms of (1) receptacles placed along walls on 9-in. centers on common wireways, and (2) elevated free-standing receptacle boxes connected via 12-in. conduit stubs to 12-by-18-in. waterproof JBs set flush in floorslabs (of high- and low-temperature labs on upper floors).

Wiring related to all local service stations is run in conduit which is (a) carried through 4-in. floorslabs when diameters are 1 in. or less, (b) carried through a 3-in. fill poured on top of slabs when diameters are 1¼-in., and (c) carried beneath slabs (along ceilings of lower-level floors) when conduit diameters are 1½-in. or larger.

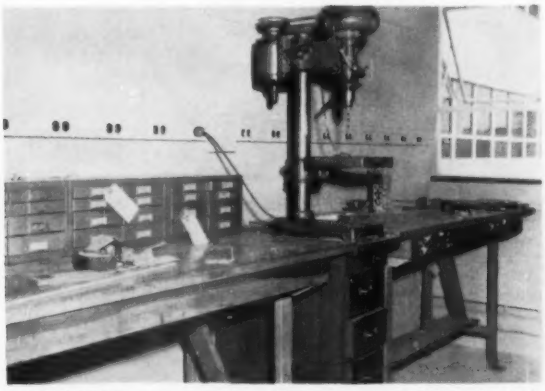
With these many features related to electrical capacity, flexibility, safety, switching, continuity and control, the system constitutes an unusually effective agent for its designed educational purposes.

Responsible for the design and installation of the system were the coordinated efforts of architect John McNamara of New York City; electrical engineering consultants Slocum & Fuller, likewise from N.Y.C.; and Lightning Electric Service Co., Newark, N. J.

PLUG-IN COPPER BUSDUCT sub-sections, connected via cable in conduit to either power distribution panels or to another main busduct feeder, are installed to serve concentrations of load in various labs or basement mechanical rooms. Plug-in breakers and branch conduit runs to local equipment sites are compactly and neatly arranged above level of suspended louvered lighting fixtures.

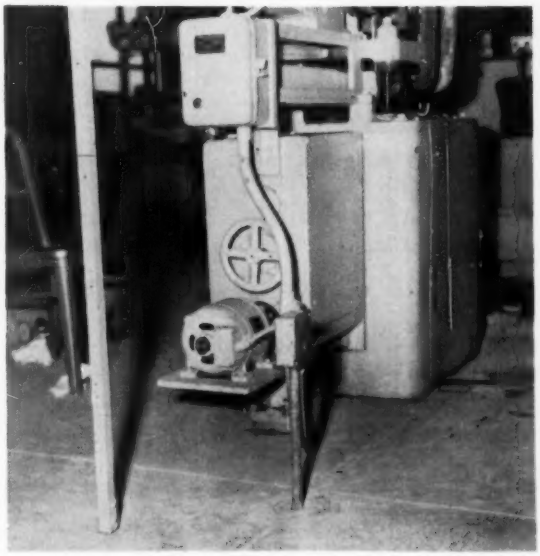


STARTER RACK has 12- by 12-in. wiring trough at bottom and similarly-sized enclosure at top to house stepped copper busbars. Starting equipment is supported by channel framing members, while assembly is braced away from wall to permit both front and rear access. Branch wiring to related motorized equipment is via conduits carried down into the slab, as shown at the bottom center.



SHOP AREAS, where bench equipment and portable hand tools dictate multiplicity of outlets, are equipped with duplex receptacles spaced along flush-mounted or semi-recessed wireways.

MOTORIZED EQUIPMENT in open floor areas obtains power via conduit stubs, free-standing junction boxes and flexible armored-cable connections that effectively segregate vibration from rigid distribution installation.



The slight deviation from the true linear curve is due to magnetic in-

New SCR Dimmer

Speeds Light-Control Progress

New midget-sized Silicon Controlled Rectifier makes possible tremendous size and weight reductions and improved performance characteristics in diminutive new dimmers; opens up completely new concept of lighting control.

By Robert A. Langer, *Chief Engineer, Kliegl Bros., New York, N. Y.*

THE field of lighting control has taken a major step forward with the development of the recently announced silicon controlled rectifier (SCR) dimmer. This new device brings with it an almost unbelievable reduction in size and weight at a time when these factors have been proving to be a serious design problem in new building construction and modernization work.

Development of semi-conductors and the introduction of the transistor gave indication—some years ago—that one day they might handle the currents involved in lighting control. Target date for when this new dimmer would be possible was set for approximately 1960.

Late in 1957 the silicon controlled rectifier was announced by the Semi-Conductor Products Division of the General Electric Co. It had limited current ratings, but the voltage ratings were such that its potential for dimmer use was recognized. Its current carrying capacity was soon uprated, and its practicability was established.

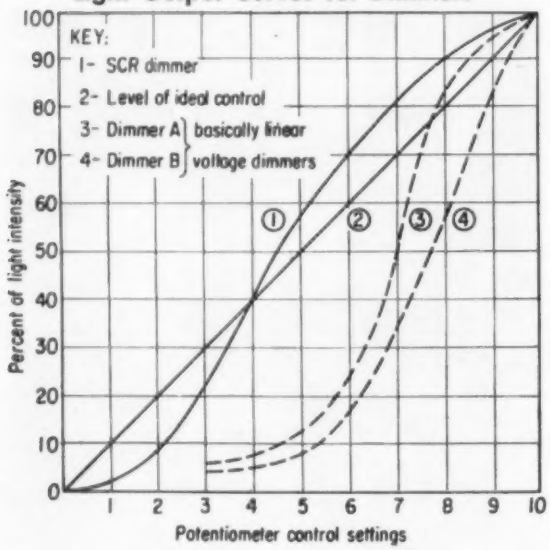
The device, which bears a great resemblance to a ¼ in.-20 nut and bolt to which some wires have been attached, soon proved that it had an electrical entity of its own and would not control in the same simple manner as its cousins, the thyratron tube and the transistor.

The initial high cost of the silicon controlled rectifier, due to its production on a laboratory basis, provided the time needed to develop and evaluate several different control circuits. From this testing Kliegl engineers developed the SCR dimmer circuitry, to meet the practical requirements of lighting control.

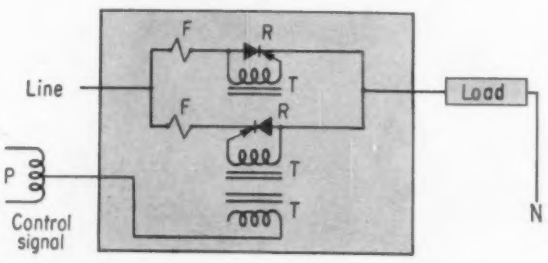
Dimmer Design Problems

Typical of the design problems involved was that of inrush current characteristics of cold incandescent lamps. Filament lamps, particularly of the high wattage type, have inrush currents in the order of 15

Light Output Curves for Dimmers

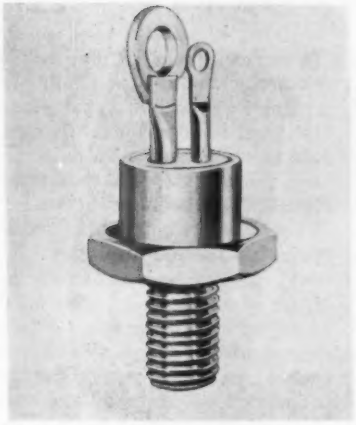


Basic SCR Dimmer Circuit

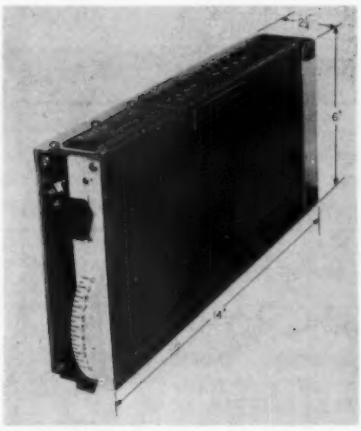


Legend:

F—Protective Fuse
R—Silicon Controlled Rectifier
T—Control Amplifier
P—Dimmer Control Potentiometer.



SMALL silicon controlled rectifier, shown above nearly twice its actual size, is heart of . . .



NEW SCR DIMMER, provides full wave rectification. Unit is small, light weight, simple. Model shown is 4-kw capacity, uses two silicon controlled rectifiers.

times steady state currents. A 2000-watt lamp could have an inrush of 250 amps and a 3000-watt lamp an inrush of 375 amps. The silicon controlled rectifier has a peak half wave current rating for one half cycle of only 200 amps. If uncontrolled, the inrush current could destroy the expensive element. The solution to this problem was found by designing into the control circuits a six-cycle integration period. In this period of time the lamp current is brought close to its steady-state value, without ever being permitted to approach more than a fraction of the normal peak values.

Another interesting design problem involved the heat sink. This is essentially a radiator which dissipates the heat developed within the silicon controlled rectifier. (This heat is due to resistive loading in the silicon junction and is approximately 50 watts for a 4000-watt lamp load.) Commercially available heat sinks proved unsatisfactory through testing. Kliegl engineers thus developed their own heat sink, which completely encloses the controlled rectifier in a high temperature silicon fluid which provides maximum heat transfer from the junction. The SCR dimmer units, equipped with these heat sinks, have been tested at loads up to 50% in excess of rating without approaching the limited temperature rating of the silicon controlled rectifier.

Practical considerations indicated that three housing forms would meet most structural requirements. One such unit, designed for modular rack assembly and easy changeability, is shown in illustration.

Light Output Curves

Virtually all previous dimmers have had linear voltage outputs related to control settings. This has resulted in dimmer control systems that were relatively inoperative below the midpoint on the controller. The effective dimming range was then compressed between settings 5 and 10 (see "Light Output Curves"). The light output curve of the new SCR dimmer has been designed to be nearly linear with the control settings. The slight deviation from the true linear curve is due to magnetic influences in the control circuit.

How Dimmer Works

The new SCR dimmer is essentially a low loss valve in series with the lighting electrical load (see "Basic SCR Dimmer Circuit"). The electrical circuit consists of two silicon controlled rectifiers in a so-called "back-to-back" assembly. Each element will permit a controlled amount of current to pass during its half of the cycle.

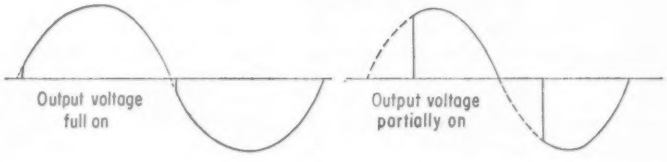
The controlling device is a pulsing transformer energized from a remotely located potentiometer.

The silicon controlled rectifier has a very low forward resistance which accounts for its high operational efficiency, which is 98.5%. This low forward drop also makes possible a voltage drop across the dimmer of only a few volts at full load. This results in regulation of about 98%.

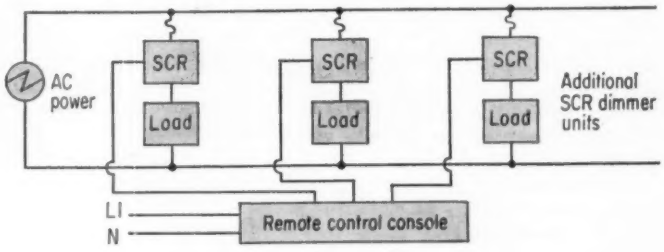
The control signal circuit operates at 24 volts, with currents in the order of milliamperes. This control circuit could be either ac or dc. Experience has dictated the selection of dc for the SCR dimmer control circuits.

The output voltage of the SCR dimmer is sinusoidal and resembles the controlled firing of a thyratron tube. Typical "full on" and "partly dimmed" outputs are shown in the "SCR Dimmer Output Waveforms" illustration. This wave form indicates that balanced load-

SCR Dimmer Output Waveforms



Block Diagram of SCR Dimmer System.



Relative Performance Characteristics of Available Dimmer Systems

	Auto-transformer (Motor Driven)	Magnetic Amplifier	Electronic (Thyratron)	SCR Dimmer
Weight of Dimmer Component Per Kw of Load Capacity	10 to 15 lbs	15 to 25 lbs	8 to 10 lbs	1 1/4 lbs
Size of Dimmer Component Per Kw of Load Capacity	1/4 to 1/2 cu ft	1/6 to 1/2 cu ft	1/4 to 1/2 cu ft	1/32 cu ft
Efficiency	95 to 97%	90 to 95%	90%	98.5%
Response, on-off	Selected speeds available from 6 to 45 seconds	0.4 to 1 1/4 sec. lag, depending on loading	Virtually instantaneous	Virtually instantaneous
Loading	Essentially infinite	from 30 to 1 to 100 to 1	Infinite	Infinite
Auxiliary Apparatus	None	Booster transformer	Auxiliary or booster transformer	None
Noise	60-cycle hum	60-cycle and 120-cycle hum	Tube conduction	None
Approximate Dimmer Bank Cost Ratio (Less Controls)	100%	200%	175%	175%

ing may be obtained on 3-phase 4-wire systems.

Another advantage of the low forward resistance of the silicon controlled rectified is indicated at this point. In contrast with the large voltage drop which occurs across thyratron tubes during conduction, the small voltage drop across the SCR dimmer results in an almost negligible amount of electrical "noise" in the power circuits. This is of utmost importance where other sensitive electronic equipment may be in use nearby.

The SCR dimmer has been tested extensively in intimate proximity to low level switching circuits, to audio equipment, and to sensitive color television cameras. Electrical "noise" was lower than average "noise" in the feeder circuits, thus supplementary filtering is not necessary with this dimmer.

Control wiring for a SCR dimmer control system is done in a simple, straightforward manner, as shown in the block wiring diagram illustration, and remains simple even when applied in a multiscene preset system.

What of Its Future?

Present indications are that the silicon controlled rectifier dimmer will ultimately take the place of all presently known types of dimmers, including the manually operated autotransformer types. The SCR dimmer control system, in spite of relatively high silicon controlled rectifier costs, is already competitive in price with the magnetic amplifier and thyratron tube type dimmer control systems.

The 4000-watt SCR dimmer is the first size to go into production. Other sizes already under consideration and on the way include 2-kw, 5-kw, 10-kw and 12-kw models.

Life expectancy of the silicon controlled rectifiers is considered to be in the order of 15 to 20 years. As production steps up, costs will decrease rapidly. Thus replacement costs of these controlled rectifiers in systems installed now will most assuredly be very nominal.

The light weight, small size and inherent remote control features of the new dimmers are already pointing the way to cost reductions in the building construction field. Three projects now under way point up these advantages:

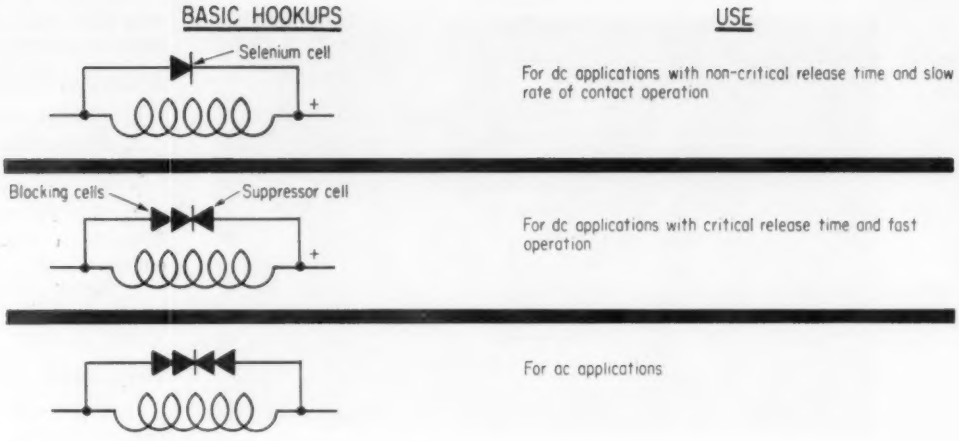
1) An existing TV studio has a bank of 12 manually operated dimmers and must expand to 24 dimmers. The necessary additional space can be had only by removal of a soundproofed wall and conversion of an adjoining room. The removal of the existing dimmers and the installation of 24 new SCR dimmers will cost less than the structural changes.

2) The dimmers in a new TV studio, now being planned, will all be of the new silicon controlled rectifier type, located at the lighting equipment elevation, and distributed over the area at lighting equipment (and electrical load) centers. Primary wiring will go directly to these load centers, and secondary circuits will in no case be longer than 20 ft. Former practice, with the dimmers occupying valuable floor space, also included secondary runs which in extreme cases were as long as 200 ft. The light weight of the SCR dimmer (1.25 lbs per kw) makes the remote location method feasible without requiring added structural members. The savings in the electrical distribution system will also be appreciable.

3) A restaurant now nearing completion in a new office building requires a large number of motor-driven dimmers. The resultant floor loading of 250 lbs per sq ft for the old style dimmers required expensive structural strengthening. The existing air system was inadequate to keep the room within proper temperature limits due to heat losses, and further expensive alterations were required.

The SCR dimmer was not available when this project was planned, but cost studies have shown that an appreciable saving could have been effected by its use.

The many inherent advantages of the silicon controlled rectifier dimmer, including its long life expectancy, with resultant negligible maintenance costs, and its obvious lower overall system cost, will result in ready acceptance and wide usage in the immediate future.


BASIC HOOKUPS
USE
Selenium cell
For dc applications with non-critical release time and slow rate of contact operation
Blocking cells
Suppressor cell
For dc applications with critical release time and fast operation
For ac applications

Reduce maintenance costs by . . .

Protecting Electrical Contacts

A practical method of contact protection using small dry-type rectifier units for arc quenching at contacts in coil circuits of relays, solenoids, contactors and similar inductive control devices.

By Howard T. Bailey, E. E., Universal Foundry Co., Oshkosh, Wis.

THE rapid increase in automation in industrial plants has created many new uses for relays, limit switches, solenoids and electromagnets of various descriptions. This increase in the use of these devices has created a problem in the maintenance of these contacts. Burned out coils and pitted contacts are commonplace unless proper steps are taken to lessen the "inductive kick" that develops in these circuits.

What Causes Arcing in Inductive Circuits?

Inductive kick can be analogous to a compressed spring in a mechanical device. Consider the circuit as shown in Fig. 1 in order to simplify this analogy:

When contacts C_1 close, the current flow as indicated by the ammeter builds up to 400 ma. Now, in terms of mechanical analogy with a compressed spring, the flow of current has made a magnet of the iron core and a magnetic field has been set up through the core. Electrical energy has been stored in the magnetic field by the current just as mechanical energy has been stored in the spring by compressing it.

Now open contacts C_1, breaking the steady flow of current. Just as the stored mechanical energy would immediately burst out when the compressing force is removed from the spring, when the contacts are opened the magnetic field will start to collapse. While it is collapsing it will try to force current through the coils in the same direction as the current which built up the field. As the current cannot flow after the contacts are opened a very high voltage is produced. This is called "inductive kick".

Immediately upon opening of contacts C_1, the current flow is suddenly stopped and the voltage which appears across the coil should theoretically go to infinity. But due to insulation resistance and other factors the voltage actually

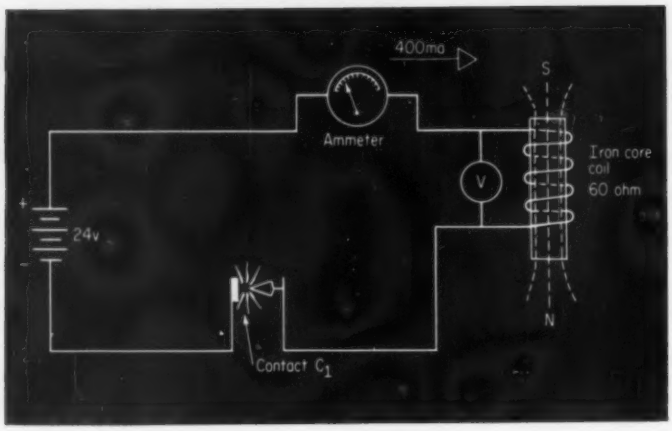


FIG. 1. Unprotected contact circuit is subject to arcing troubles due to induced voltage kick from coil.

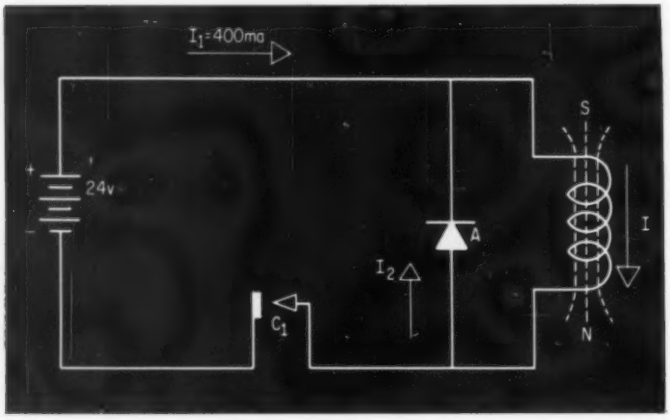


FIG. 2—Half-wave selenium rectifier protects against arcing where the release time of the relay is not critical and where the rate of operation of the contacts does not exceed about 10 breaks per second.

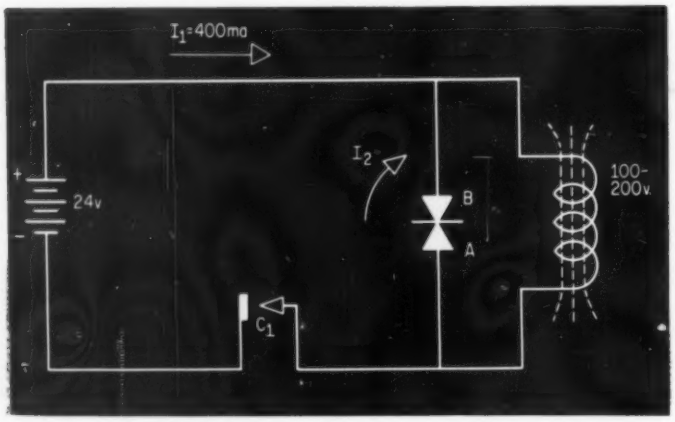


FIG. 3—Full-wave, back-to-back hookup of selenium rectifiers provides arc suppression, with negligible effect on release time of relay, in circuits where rate of contact operation is in the range from 10 to 40 breaks per second and in ac circuits.

may rise to 300 to 1000 volts in an average 24-volt coil.

Effects of Contact Arcing

1. Contact erosion and pitting.
2. Mechanical locking and sticking contacts.
3. Radio noise radiation.
4. Coil insulation puncture and breakdown due to high voltage spikes.
5. Erroneous triggering of adjacent sensitive control circuits due to spurious transients created.

Ways to Prevent Contact Arcing

One method commonly used to prevent arcing is by the use of a capacitor-resistor network across the coil. This method introduces a time delay in the inductive-kick discharge so that the high voltage peak occurs somewhat later, allowing the contact gap to widen and consequently requiring a higher voltage to jump across the gap. Gap width and gap arc voltage are mathematically related; i.e., the wider the gap the higher the voltage required for arcing.

There are, however, some disadvantages in using a capacitor-resistor network to prevent contact arcing. Their space requirements are a definite disadvantage in modern control panels due to the miniaturization trend. Selection of the correct values is very important in order to limit discharge during switching operation or serious contact burning will result.

Another method for combating contact arcing in inductive circuits has been developed which has many advantages over methods previously used. This involves the use of a selenium rectifier specially processed to exhibit favorable characteristics, such as very low leakage current and low forward resistance.

A selenium rectifier will pass current in one direction readily but opposes current flow in the other direction. Fig. 2 illustrates how this rectifier is connected in a circuit directly across the coil. There will be none of the 400 ma current normally flowing through the rectifier.

As indicated in Fig. 1, when the contacts C_1 were opened we observed that the property of inductance builds up a high induced voltage that attempts to maintain the steady state current flow through the coil in the same direction. Previously, the high energy had to

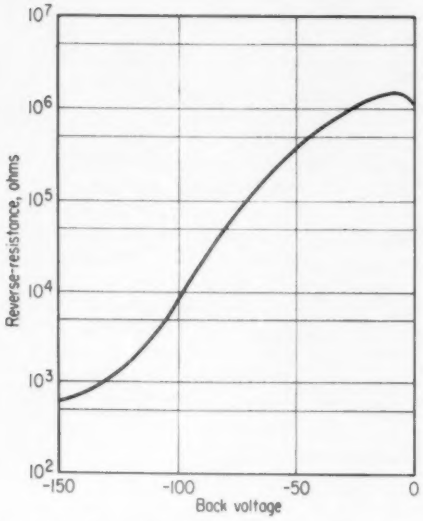
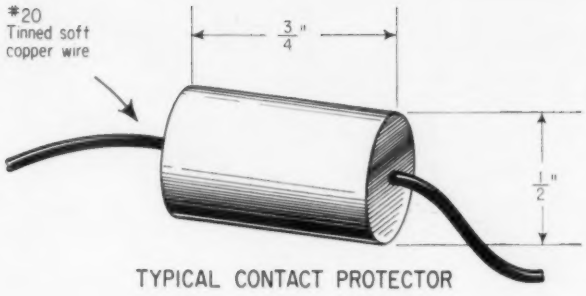


FIG. 4—Resistance characteristics of a selenium rectifier for back voltage.



Back-to-back unit for 45-66 vdc, 600ma peak current
Selection of units is based on voltage and the steady state current drawn by the coil to be protected

FIG. 5—Selenium contact protectors—both half-wave and back-to-back units—are available in small encased, tubular units with axial, tinned copper leads for ready connection across coil terminals without any need for additional mounting brackets or lugs.

force its way across the separating contacts in order to equalize the charge on both ends of the coil. Notice in Fig. 2 that a low resistance is provided through the rectifier and current I_2 flows when C_1 is opened. The voltage across the contacts does rise above the battery voltage but does not approach a high enough level to cause arcing trouble.

It can be shown mathematically that the length of time for current I_2 to drop to zero is inversely proportional to the sum of the coil resistance and forward resistance of the contact protector. Therefore, since our coil resistance is usually low, and the forward resistance of the contact protector is lower, current I_2 tends to flow for a much longer time than it takes for the coil to die down to zero in an unprotected circuit. Typical values for the release time for a telephone type relay used in Fig. 2 is 55 milliseconds. In unprotected circuits it is much faster, namely 7.7 milliseconds. This time-delay characteristic in the release of the coil would present unfavorable results in some circuits while presenting no problems in others.

From analysis of circuit operation, maximum spark suppression is obtained when the rectifier unit has as low a forward resistance as possible. But, as indicated above, such an arrangement produces a long release time. The most desirable conditions would be that in which contact arcing is suppressed with little or no increase in the release time of the coil. Such operation can be obtained when selenium rectifiers are connected back-to-back across the coil. With such a hookup, forward current through the rectifiers is blocked; potential across contacts is higher than in the case of a single rectifier but still below arcing level; and release time is almost as short as in the case of unprotected contacts. When the contacts open, the blocking rectifier then acts as a short across the coil; and the suppressing rectifier acts as a high impedance to minimize release time.

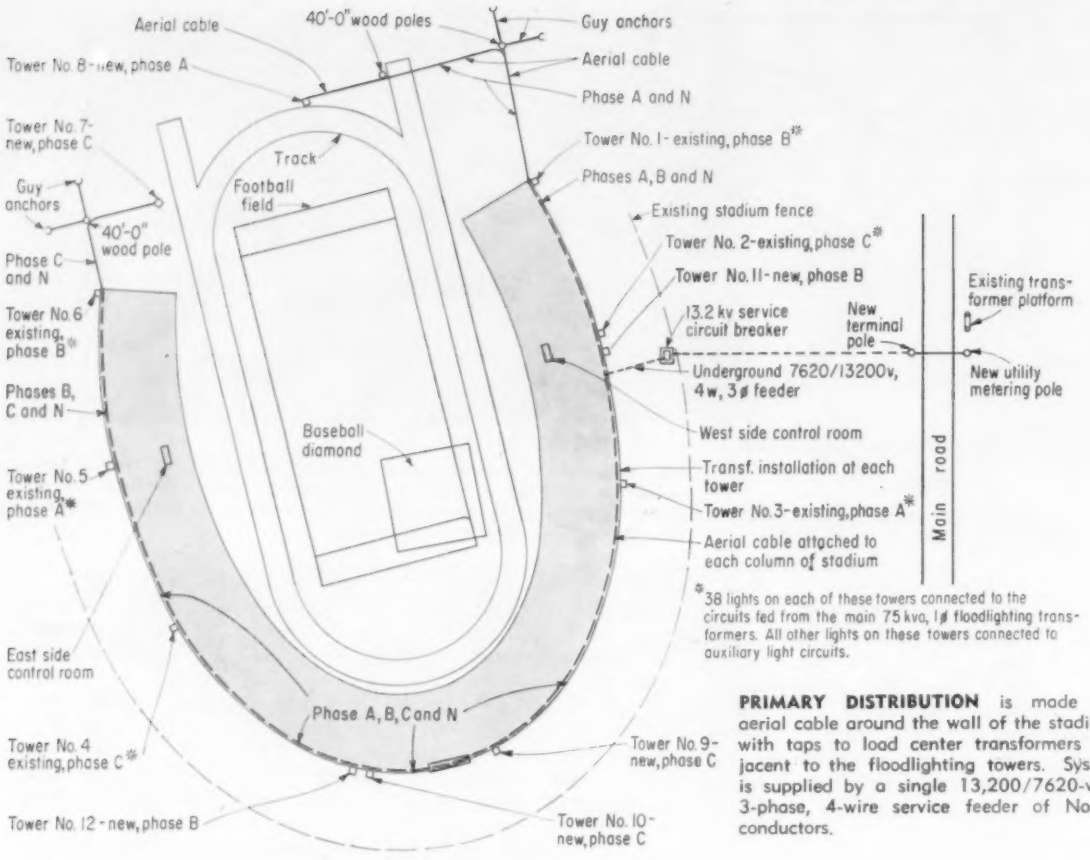
Fig. 3 shows a decided improvement over the single-rectifier circuit in that the time delay factor has been substantially reduced; i.e., from 55 to 10.5 milliseconds—only 4 milliseconds longer time delay than when no contact protection is provided for, yet arc suppression has been retained. Notice that the rectifier cell "B" has been added in such a direction that it opposes the discharge current I_2.

A selenium rectifier has a unique characteristic of exhibiting decreasing resistance with increasing voltage in the blocking direction. At the instant C_1 is opened in Fig. 3, there is still up to 200 volts induced across the coil even with "A" cell in the circuit. This appears as a reverse voltage across cell "B" (no current in the direction of "B"). However, it so happens that at −150 volts (back voltage) the reverse resistance of "B" is approximately 300 ohms, which is low enough to allow considerable current I_2 to flow and quickly dissipate the induced energy. As the energy is dissipated, the induced voltage across the coil drops very rapidly, which in turn lowers the back voltage across "B". As shown in Fig. 4, the resistance of "B" to I_2 has increased to a value of nearly one megohm when the voltage has dropped to −25 volts.

As shown in Fig. 3, the rectifier cell at "A" is used to block the dc battery voltage from shunting the coil. A single selenium cell is normally rated at 22 volts dc. In any dc circuit enough rectifier cells can be connected in series to provide blocking of the particular voltage. In dc circuits, there is no need to match the number of suppressor cells to the number of blocking cells. Increase in the number of cells at "B" in Fig. 3 will shorten the release time of the coil but will also increase the induced voltage across the contacts.

A particular advantage of the back-to-back hookup is its ready applicability to ac circuits. In such cases, however, the number of suppressor cells must be equal to the number of blocking cells.

Back-to-back selenium rectifier cells are available in small, tubular encased units which are designated as "contact protectors" and have axial leads to afford ready connection across coil terminals. Operating characteristics and other spec data on such units are available from the Components Division of International Telephone and Telegraph Company, Clifton, N. J.


Aerial cable
40'-0" wood poles
Guy anchors
Tower No. 8 - new, phase A
Aerial cable
Phase A and N
Tower No. 7 - new, phase C
Tower No. 1 - existing, phase B*
Track
Football field
Guy anchors
Phases A, B and N
Existing stadium fence
40'-0" wood pole
Tower No. 2 - existing, phase C*
Phase C and N
Tower No. 11 - new, phase B
Existing transformer platform
Tower No. 6 existing, phase B*
13.2 kv service circuit breaker
New terminal pole
Underground 7620/13200v, 4w, 3ø feeder
New utility metering pole
Phases B, C and N
Baseball diamond
West side control room
Transf. installation at each tower
Tower No. 5 existing, phase A*
Tower No. 3 - existing, phase A*
Main road
Aerial cable attached to each column of stadium
East side control room
Phase A, B, C and N
Tower No. 4 existing, phase C*
Tower No. 9 - new, phase C
Tower No. 12 - new, phase B
Tower No. 10 - new, phase C
*38 lights on each of these towers connected to the circuits fed from the main 75 kva, 1ø floodlighting transformers. All other lights on these towers connected to auxiliary light circuits.

PRIMARY DISTRIBUTION is made via aerial cable around the wall of the stadium, with taps to load center transformers adjacent to the floodlighting towers. System is supplied by a single 13,200/7620-volt, 3-phase, 4-wire service feeder of No. 2 conductors.

Primary aerial feeder provides . . .

Distribution for Floodlighting

Design and construction details on a modern outdoor electrical system supplying floodlight clusters on steel towers spaced around the outside wall of City Park Stadium in New Orleans, La. B. Z. Segall, consulting engineer, designed the system which was installed by Victory Electric Works, Inc., New Orleans.

By J. F. McPartland

A LONG aerial cable primary feeder is the basic distribution element for a modern floodlighting system at City Park Stadium in New Orleans. Here, the new overall electrical system represents a modernization and expansion of an old system used for lighting the stadium. A new service was brought in, circuiting was redesigned to provide advantages of high voltage, and old equipment was integrated into the new system. A close look at this installation reveals the relative simplicity and high efficiency with which large blocks of power are delivered

to widespread load concentrations.

The enclosing structure of the stadium is shaped like an elongated horseshoe, open at one end. The layout includes a football field, a baseball diamond and a cinder running track. Prior to the new installation, a total of six steel towers supported the floodlights for illuminating the field. Power supply to the stadium formerly consisted of a 3-phase 4-wire, 120/208-volt service. The new installation was made to bring field lighting and parking lighting up to modern standards and to provide additional capacity for miscellaneous power and light facilities at the stadium.

The renovated lighting system consists of a total of 12 steel towers supporting 40-lamp floodlight arrays. Six new steel towers were added around the outside wall of the stadium. These are similar in size and construction to the old towers and are spaced to provide lighting from an oval layout surrounding the field. Circuiting and arrangement of all of the floodlights—those on existing towers and those on new towers—were completely designed as a new installation supplied from a new over-all distribution system.

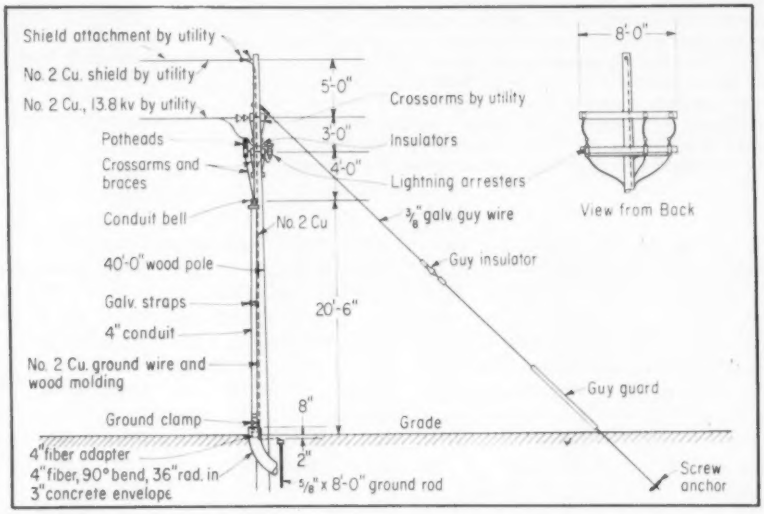
In design of the new distribution system, it was quickly recognized that high voltage distribution of power offered many advantages. Substantial economy in conductor cost and switching and protection equipment was provided by carrying power at primary voltage to each of the widespread load concentrations. And the construction of the stadium was ideally suited to the use of aerial cable as the primary feeder supported on the wall around the stadium with stepdown transformers at each tower.

Power for the new electrical system at the stadium is provided by a single primary service to the premises. From a utility metering pole at the edge of the property, a 3-phase, 4-wire, wye, 13,200/7620-volt overhead line is carried a short distance to a terminal pole on the property. From this point, the service feeder is carried underground to an outdoor, metal-enclosed power circuit breaker which provides service disconnect and overcurrent protection in accordance with sections 2388 and 2389 of the NEC.

The main CB is an oilless type and is capable of interrupting the maximum short circuit current to which it might be subjected at that point in the system (section 2389-d). It is rated at 13.8 kv, 1200 amps continuous load current, with its trip adjusted to protect the No. 2 conductors which adequately handle the total system load current. This breaker has a momentary short circuit current rating of 20,000 amps, the maximum asymmetrical current that the unit can withstand. It also has a 3-phase rating of 150 mva interrupting capacity and an interrupting rating of 6300 amps at rated voltage of 13.8 kv. In the installation at this stadium, the load is virtually all lighting, eliminating any possible short circuit current build-up due to motor loads. As a result, the circuit breaker interrupting rating had to be matched to only the interrupting duty of the supply line. Short circuit duty was obtained for fault at the utility pole and then reduced by the impedance of the run to the main CB.

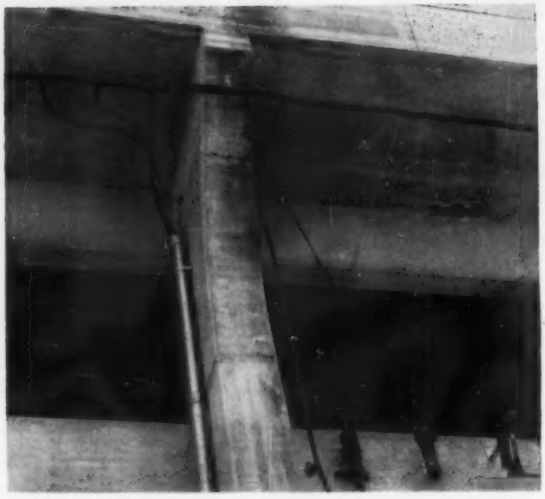
In this installation, careful selection was made of the main service disconnect and protection. A CB was chosen instead of any interrupter switch and fuse combination because of the utilization conditions which prevailed. Because the stadium electric system is used

SERVICE CB is a 1200-amp, oilless power breaker installed in the weathertight enclosure within the fenced area and fed underground from terminal pole at edge of property off to right. Load-side conductors are carried underground to base of stadium wall off to left.



TERMINAL POLE on edge of city park property is fed by overhead line from utility metering pole. Service conductors are carried down pole in conduit and then run underground to service CB enclosure. Wiring to the lower crossarm was done by utility.

TYPICAL LAYOUT of equipment at each transformer load center adjacent to each tower is shown here at tower No. 11 opposite main service CB. Conduit on side of column at left carries No. 2 service feeder conductors from main service CB up to splice to aerial cable feeder. Wood molding on wall section below transformer protects grounding conductor which grounds lightning arrester, transformer neutral, aerial messenger and secondary equipment enclosures. This conductor is carried under the molding down the short column and connected to a driven ground rod below the sidewalk.

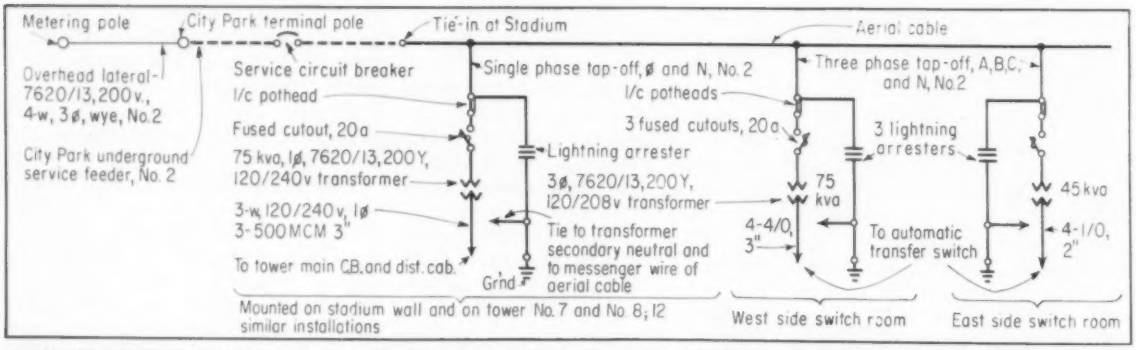


AERIAL CABLE consists of four conductors in a twisted assembly with the messenger wire wrapped around the cables. The complete assembly is supported at each column by a small hanger bolted to the concrete. Service conductors are shown here emerging from 4-in. conduit, at which point they are tied to a porcelain insulated standoff mounted on the wall and then spliced to the aerial cable conductors. A tap down to load center transformer is at right.

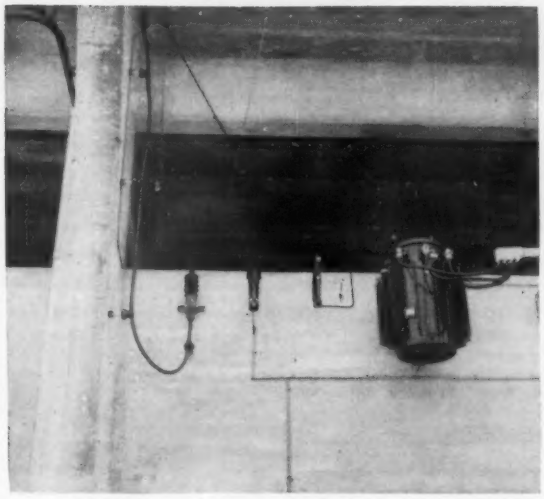
only at specific times and for relatively short durations, the service disconnect will be operated very frequently. At times when the stadium is not in use, the system should be dead to eliminate hazard due to tampering with the exposed primary feeder ring. Otherwise a guard would be necessary. And because operating personnel at the stadium would not be skilled in use of electrical distribution equipment, it was felt that the disconnecting device should be safely and readily operable by any non-electrical person. The electrically operated CB best met all of the requirements here.

From the load side of the main CB, a 3-phase, 4-wire, 13,200/7620-volt underground feeder of 15-kv, No. 2 conductors is carried in a concrete-encased 4-in. fiber duct to the foot of the stadium wall. At this point, a 90° fiber duct bend comes up in its concrete envelope and couples through a fiber adapter to a 4-in. rigid conduit riser strapped to the side of one of the concrete columns. The feeder is brought up in this conduit and spliced to the aerial cable feeder.

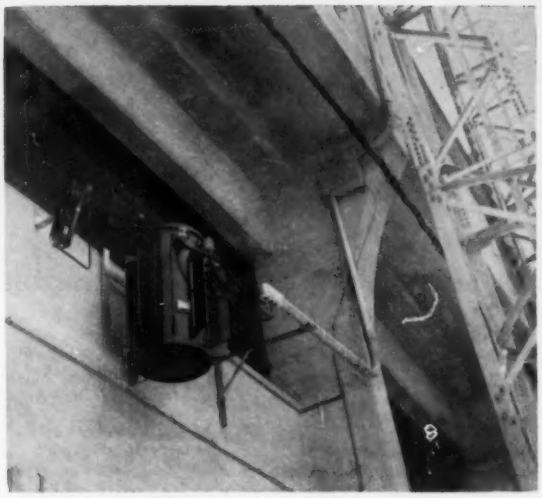
As shown in accompanying illustrations, the aerial cable around the stadium structure is tapped to feed a stepdown transformer at the location of each of the twelve floodlight towers. The tap for each tower transformer consists of one phase conductor and the neutral to supply the 7620-volt primary of each 75-kva, single-phase transformer. From the 120/240-volt, 3-wire, single-phase secondary of each transformer, three 500MCM conductors are carried in 3-in. rigid conduit up to a main, motor-operated, remote-control circuit breaker mounted in a weatherproof cabinet on the tower structure. The CB is installed at the height of the stadium wall to provide ready servicing from the top of the stands. From the load side of the breaker,


Metering pole
City Park terminal pole
Tie-in at Stadium
Aerial cable
Overhead lateral-7620/13,200v., 4-w, 3ø, wye, No.2
Service circuit breaker
Single phase tap-off, ø and N, No.2
Three phase tap-off, A,B,C, and N, No.2
l/c pothead
l/c potheads
City Park underground service feeder, No. 2
Fused cutout, 20a
3 fused cutouts, 20a
3 lightning arresters
Lightning arrester
75 kva, lø, 7620/13,200Y, 120/240v transformer
3ø, 7620/13,200Y, 120/208v transformer
75 kva
45 kva
3-w, 120/240v, lø 3-500MCM 3"
4-4/0, 3"
4-1/0, 2"
Tie to transformer secondary neutral and to messenger wire of aerial cable
To automatic transfer switch
To tower main CB and dist. cab.
Grnd.
Mounted on stadium wall and on tower No. 7 and No. 8; 12 similar installations
West side switch room
East side switch room

ONE-LINE DIAGRAM of distribution system shows a typical arrangement for one of the twelve tower floodlighting loads and the taps for 3-phase power to transformer load centers in the two stadium switchrooms.



LOAD CENTER transformer layout is fed by a single 15-kv, No. 2 phase conductor tapped down from aerial cable and supported by porcelain insulator standoffs mounted on wall. Conductor terminates in pothead at left. Connection to transformer 7620-volt primary also includes a lightning arrester (at right of pothead) and a 20-A fused cutout for protection of the transformer and its secondary feeder. Circuit to transformer primary is completed by No. 2 grounded neutral which is tapped from neutral of aerial cable and brought down (out of sight at right) to the transformer hookup.

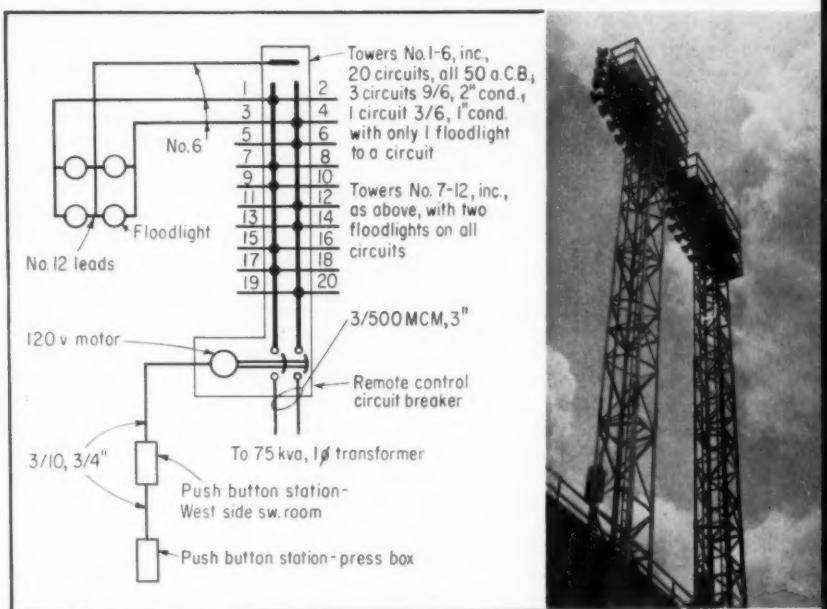


SECONDARY FEEDER from each single-phase, load-center transformer consists of three 500MCM conductors (two hot and a grounded neutral) carried into a 3-inch conduit and up to the remote-control CB mounted on the tower. Tap to aerial neutral can be seen adjacent to pull box on side of column. Conductor is brought down into wood molding in which it is carried to transformer primary and secondary connections, to lightning arrester and to ground. Secondary raceway and enclosures are also grounded by connection to this conductor.

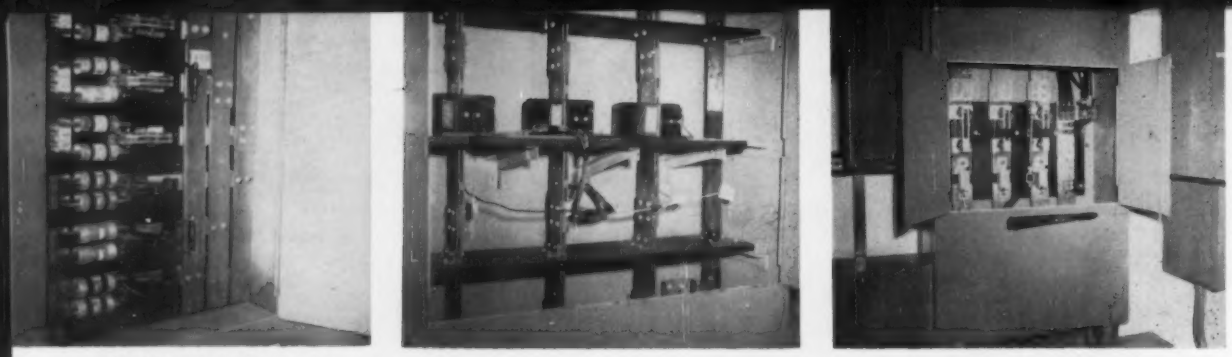
the sub-feeder circuit continues in conduit to a branch circuit panelboard in a weatherproof enclosure at the top of the tower. The individual floodlights are supplied from this board.

In addition to the 12 taps to the single-phase transformers, two other taps are made from the aerial cable. Each of these is a 13,200/7620-volt, 3-phase tap—one to a 75 kva, 3-phase transformer in the west side switch room and the other to a 45-kva, 3-phase transformer in the east side switch room. The 3-phase, 4-wire, 120/208-volt secondary of each of these transformers feeds panelboards for miscellaneous lighting and receptacle circuits. These loads include auxiliary lighting from two floodlight units on each of the existing towers. These lights are on circuits run from a panelboard in each switch room to the lighting towers. Each of these panelboards is controlled through an electrically operated CB from the master pushbutton control station in the west side switch room. These auxiliary lights face the field and the parking area to provide a very low level of lighting for use at dusk or when otherwise needed. Other panelboards in the switch rooms supply circuits for high level lighting of all parking areas, ramps throughout the stadium, dressing rooms and concession areas.

In each switch room, the various lighting panelboards are supplied from the 3-phase transformer through an automatic transfer switch. In the event of failure of the primary supply to the field, the ATS will connect these panels to an emergency service switch supplied by the old 120/208-volt service.



TOWER CIRCUITS originate in a weatherproof panelboard at the top, fed through a remote-control circuit breaker mounted on tower structure at level of top of stadium wall. Installation is the same for all twelve towers. Circuiting of floodlights is indicated in diagram.



METER ROOM EQUIPMENT. Enclosed wireway beneath utility end box and 2000-amp pressure switch (right) contains 2000-amp double ¼ by 4-in. copper bus which extends from switch through CT cabinet (center) to line side of two 1200-amp fused knife switches (left). Lower 1200-amp switch feeds existing press room panels on opposite side of room; conductors on load side of upper switch feed busway. Cabinets at extreme right in right-hand photo contain 400-amp and 200-amp service switches for bank and other commercial tenants, respectively.

Newspaper Plant Modernizes with

Increased Service and Feeder Capacity

for growing lighting and office machine load.

GRADUAL improvement in lighting conditions, an increase in the use of office machines and miscellaneous equipment, and anticipated need for air conditioning capacity in the Reporter Dispatch Building, White Plains, N. Y., necessitated replacement of the existing 1140-amp service and associated building risers.

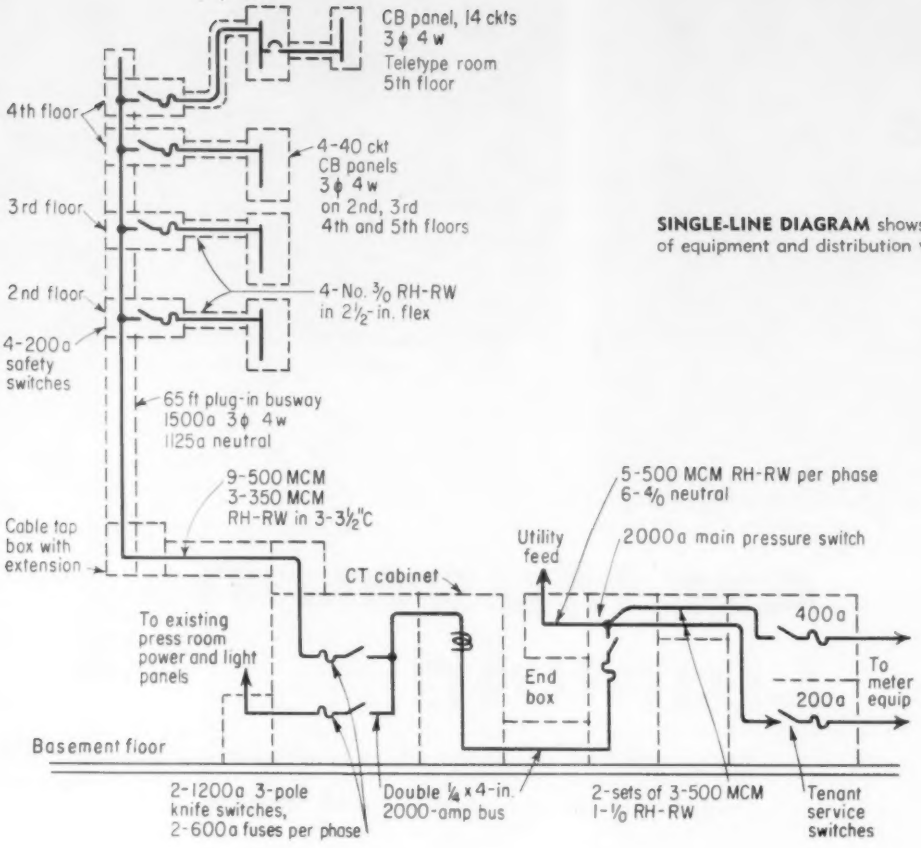
Although a 2000-amp pressure switch had been installed previously, service consisted only of three 500MCM RH-RW conductors. The main switch fed a main distribution panel serving the entire building load. The new installation, put in by William Fath, electrical contractor of Mount Vernon, N. Y., uses three main means of disconnect: the 2000-amp pressure switch for the Reporter Dispatch load, a new 400-amp switch for the bank, and a 200-amp switch for the other commercial tenants.

First step was to build up the service capacity to 1900 amps by increasing the existing service to five 500MCM RH-RW per phase with six 4/0 neutrals from the utility end box to the 2000-amp pressure switch. The old switch was retained, but it was enclosed in a new cabinet. To avoid any weakening of the masonry walls of the meter room because of the weight of the electrical equipment, the new switch cabinet as well as all other new equipment was mounted on specially constructed floor-standing steel racks. The entire load is thus carried by the basement floor, with only retaining bolts set into the walls.

New 2000-amp bus was fabricated and installed from the load side of the pressure switch through a metal trough to a new CT cabinet and then to the old main distribution panel. This panel had previously enclosed three feeder switches of 1200, 400 and 200-amp capacity serving press room power and light, the bank, and other commercial tenants on the first floor. The 1200-amp switch was retained for the press power and light; the other two smaller switches were removed and replaced with a second 1200-amp knife switch for office power and light. The office load, previously fed from single-phase fuse panels on the second, third, fourth and fifth floors, was carried to the floors in 1½- and 2-in. conduit from basement knife switches outside the meter room. These knife switches and risers were abandoned. The risers were replaced by a single 65-ft vertical run of 1500-amp aluminum plug-in busway with 1125-amp neutral, installed in one corner of the main stairwell.

The busway was tapped on the second, third and fourth floors to feed individual floor panels, the fourth and fifth floors being both fed from fourth-floor taps to avoid the necessity of running the busway to the fifth floor.

Taps were accomplished using fusible 4-pole, solid-neutral safety switch plug-in units rated at 200 amps, 25 hp. To avoid running exposed raceway completely around the hallways from the stairwell to the utility closets in which the floor panels are located, 3/0 RH-RW feeders from the busway taps were pulled into 2½-in. flexible metallic conduit which was fished through the spaces between floors from the stairwell to the closets. Copper seals



SINGLE-LINE DIAGRAM shows arrangement of equipment and distribution wiring.

were installed at all points where busway passes through the ceiling. This flashing completely encloses the busway and extends about 2 ins. above the floor level. This prevents any accumulated water which may leak from the fire hose system from running down the busway and entering switch or bus enclosures.

Existing single-phase, toggle-switch-fuse panels in the closets were removed and replaced with 40-circuit, 3-phase, 4-wire, recessed circuit breaker panels. Existing branch circuits were picked up and distributed equally among the three phases. On the fifth floor a new teletype room was relighted and provided with a 14-circuit breaker panel, fed from a 50-amp, 3-phase breaker in the closet panel by four No. 6 RH in 1¼-in. conduit.

A time-clock controlled blower fitted into the wall above the doorway operates during peak-load periods in warm weather to provide ventilation for the meter room.

FEEDER CONDUIT from fused switch in meter room to busway riser travels 110 ft along basement ceiling. Each 3½-in. raceway carries three 500MCM and one 350MCM RH-RW conductors to cable tap box.

CABLE TAP BOX at lower end of busway riser in basement stairwell was fitted with sheet metal extension to enclose feeder cables. Nine 500MCM and three 350MCM RH-RW conductors were connected to multiple lugs inside box.

FUSIBLE SAFETY SWITCHES were plugged into busway riser to feed floor panels. Flexible metallic conduit feeders to fourth- and fifth-floor panels are visible entering wall behind fourth-floor switches in above photo.

OBJECTIONABLE PROMINENCE of walls and furnishings under original lighting (left) was efficiently eliminated in remodeled galleries (right) by the use of specially developed spotlights. New arrangement illuminates only frame and picture areas.

Special Spotlight Developed for

Art Museum Lighting

provides economical, efficient method of eliminating objectionable background light around paintings and statuary

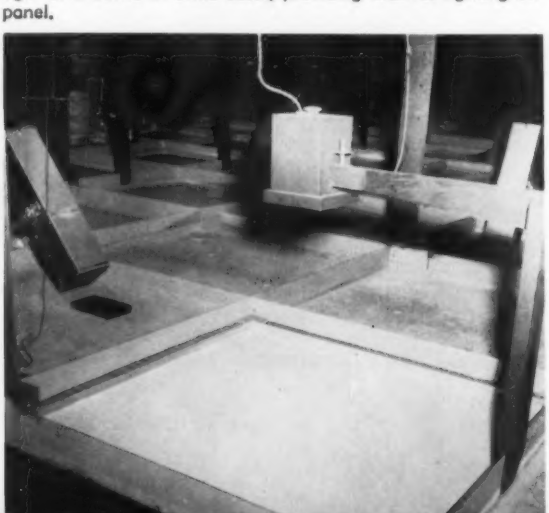
A DESIRE to improve the lighting in the galleries of the Virginia Museum of Fine Arts in Richmond resulted in the development by museum personnel of a special optical spotlight for illuminating paintings and other art objects.

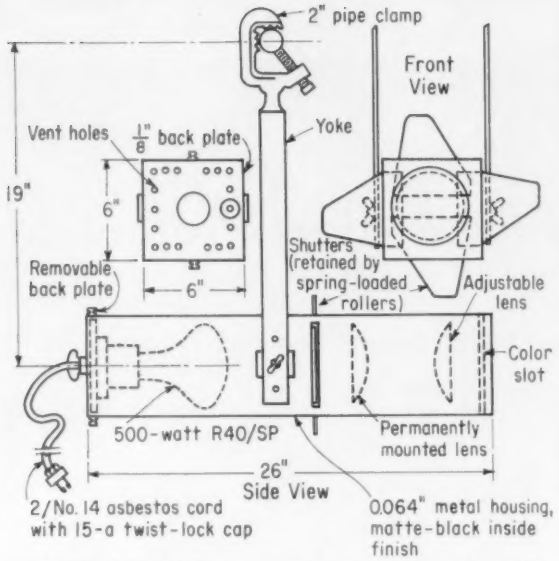
Conceived in 1935 on a relatively grand scale with a high, vaulted ceiling in the main hall and skylights in the galleries, the museum was originally provided with supplementary strips of incandescent lighting which concentrated the light, through diffusion lenses, on the wall surfaces. Being of a lighter color than the objects on display, the walls became more prominent than the art for which they served as background.

In 1954 a new wing of the original building was completed. Much thought and research had gone into

CEILING PLENUM view shows several spotlights in place. Units are connected by means of twist-lock receptacles and drop cords. Note louvered shutter over ceiling holes in foreground to provide lateral cut-off of light beam.

GENERAL ILLUMINATION of the galleries, necessary to reduce contrast between lighted objects and surroundings, was accomplished by means of a special unit utilizing the same back plate as the spotlight, suspended over translucent ceiling panels. For higher diffusion, lighting units were directed against a baffle in some cases, providing indirect lighting on panel.





SPOTLIGHT DETAILS show simple construction. Adjustable yoke and C-clamp permit mounting of unit on ceiling grid steel or 2-inch pipe. Units using 150- or 300-watt lamps have only a single adjustable lens. Shape of beam is controlled by the four reversible shutters shown, which can be trimmed to any desired shape with tin snips.

TRANSLUCENT PANELS were used for large-area lighting of interior museum sections not intended primarily for display purposes.

planning this addition to give it a high degree of control, both in manipulation of the available room in the exhibition areas and in the techniques of lighting. The galleries were created as completely blacked-out areas, devoid of windows and skylights, and elastic in the arrangement of partition walls.

Both problems—space flexibility and light control—were attacked at once, a steel grid at ceiling level being the point of division. Ample headroom was provided above the grid for workmen handling the lights, while the galleries below were left free of obstruction to facilitate movement of the temporary partitions. Expendable plywood and translucent plastic panels formed the ceiling surface, supported by the inverted T-section of the steel grid members. These sections were placed on 4-ft centers; electrical floor receptacles and mechanical attachment inserts for the partitions were aligned with the intersections of the steel grid.

To illuminate the many art objects on display, an instrument (termed the "Lusklite" after its creator) was designed and developed at the museum. Essentially, it is an optical spotlight similar in function to certain theatrical devices capable of controlling the shape of the light beam. Being designed expressly for museum use, it is compact, lightweight, economical and efficient. It employs an inexpensive reflector lamp which will operate in any direction with a life of approximately 2000 hours and can be focused in any attitude by means of an adjustable yoke support and C-clamp mount. A slot is provided at the front end of the unit for color filters where a colored beam is required. The light beam is shaped by the insertion of four removable shutters for rectangular objects or a single shutter containing a round hole, the size of which is selected for each particular application. Blank shutters may also be shaped to fit irregular objects.

75-watt lamps may be used as well as 150, 300, and 500-watt lamps, depending upon the amount of illumination desired. It has been found necessary to light the frames as well as the paintings to avoid an unnatural effect.

The light beam passes through a hole in the plywood ceiling panel which is quickly cut by means of an electrical hand router, guided by an elliptical template. Steel phonograph needles, protruding from the bottom of the template, keep it in place during the cutting operation; the wooden plug and sawdust are caught in a net below. Plugs are replaced and new holes cut as the exhibits change; entire plywood panels are replaced as necessary.

General illumination in the galleries was found to be essential to reduce the contrast between lighted objects and the surrounding background. This was accomplished by means of translucent ceiling panels lighted by floodlights placed about 2 ft above the panel. Special fixtures were devised which can be quickly mounted and which utilize the same backplate as the spotlight. The panels themselves, for the sake of safety and economy, are composed of opaque, white plastic material stretched on frames.

After completion of the lighting in the new wing, attention was turned to the original galleries. Fortunately most of the old galleries had been fitted with secondary skylights. A border of the glass panels was retained to provide general illumination, the remainder being replaced with plywood panels over which spotlights were mounted. Electrical receptacles were installed in the plenum, along with 2-in. pipe for mounting the fixtures. In the main hall, with its vaulted ceiling, slots for plywood panels were cut in appropriate positions and work platforms were constructed above, along with the installation of receptacles and pipe.

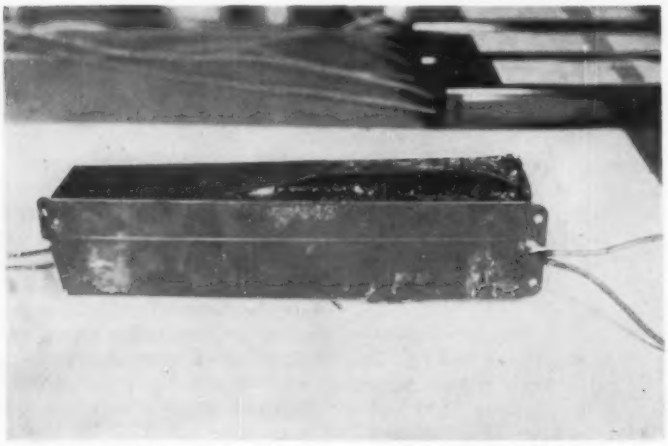
The relighting job was handled by Morris Hunter, Inc., electrical contractors of Richmond, Va.

FUSING—

An Answer To Positive Ballast Protection

The "how" and "why" of fluorescent ballast failure, plus recommended fusing procedures to prevent fixture and property damage.

By Scott Helm, *Product Planning Specialist*
General Electric Company, Ballast Department, Danville, Ill.



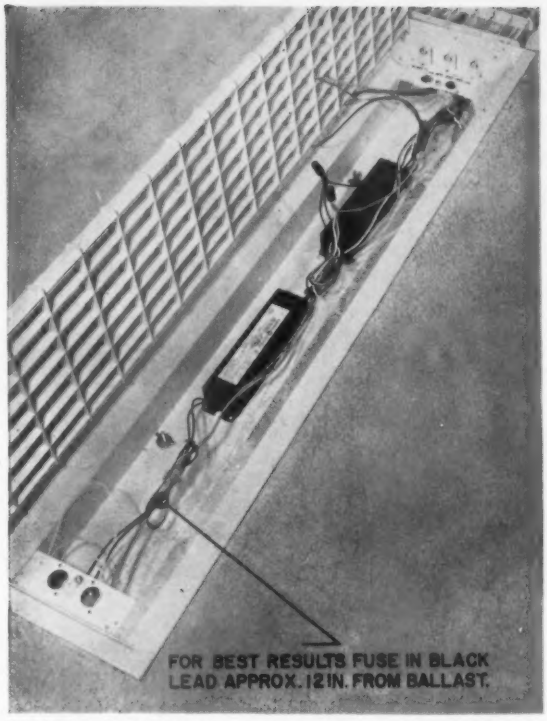
RUPTURED BALLAST can result from shorted capacitor if voltatile gases released are ignited by a reestablished arc. Proper fusing takes ballast off the line after initial short circuit, prevents possible ballast explosion.

COMPOUND SEEPAGE caused by excessive ballast overheating damages fixtures and furnishings and is hazardous to personnel. Proper ballast protection and fusing on single-lamp lag ballasts can prevent this.

SINCE the introduction of fluorescent lighting at the New York World's Fair 20 years ago, new technology and improved materials have resulted in notable improvements in fluorescent ballasts. But, despite these many changes and improvements, one characteristic remains the same—like all other electrical equipment, fluorescent ballasts must fail at some point in their life. Under normal conditions, ballasts will average 15 years of satisfactory service. Of course, some will fail short of this mark while others will better that average.

Whether failure is the wearing-out process associated with normal full-life service or whether some part of the ballast fails prematurely depends not only on the quality of the ballast but also on its proper application, and the maintenance of lamps and allied equipment. Realizing that all ballasts ultimately will fail, fluorescent lighting users should provide electrical protection which will give maximum hazard protection and optimum service. Under certain conditions, physical damage to property and personal injuries can result from ballast failure.

Why can this happen? During normal operation the "losses" of this electromagnetic device generate heat which the potting compound transmits from the ballast core and coils to the ballast case. Practical requirements of ballast design necessitate use of such organic materials as paper, asphalt, and resins. Today's ballasts are designed with adequate safety factors



BALLAST FUSES should be installed, for best results, in the fixture wireway approximately 12 in. from ballast unit.

Suggested Fuse Ratings for Fluorescent Ballasts

(Based on 110-125-volt operation. For 208-277-volt operation use fuses rated at one-half given values)

Type of Ballast	Fuse Rating —Amps
Two Lamp 40-Watt/RS Series	1.0
Two Lamp 96T12/1S Series Seq	2.5
Two Lamp 96T12/RS Series	2.8
Two Lamp 96PG17 Series	4.5
Single Lamp Slimline 120 MA	1.0
Single Lamp Slimline 200 & 300 MA	1.6
Single Lamp Slimline 425 MA-LAG	2.6
Single Lamp Slimline 425 MA Lead	1.6
Single Lamp 40 Watt/RS Lead HPF	0.7
Single Lamp 40 Watt/RS LAG HPF	2.0
Single Lamp 40 Watt/RS LAG LPF	1.6
Two Lamp Slimline 120 MA	1.6
Two Lamp Slimline—All Other	3.0
Single and Tulamp General Line	
4, 6, 8, 14, 15, & 20	1.0
All LPF Trigger-Start	2.0
Three Lamp 40 Watt/RS (2 lead —1 lag)	2.0
Single and Two Lamp 90T 17	3.0

Note: For best results, mount fuse inside fixture ballast compartment at least 12 in. from ballast.

to withstand abnormal temperatures (in excess of the allowed maximum value of 105° C); but deterioration of organic materials can and does occur under adverse operating conditions which seriously shorten the life of the ballast.

If the ballast is permitted to operate for an extended period at coil temperatures in excess of the 105° C limit, the insulation in the autotransformer coil and in the vicinity of the coil becomes overheated and carbonization of the insulation occurs. The result is a reduced resistance to ground. Should the dielectric strength of the insulation be exceeded, a ground could result between coil turns or between the ungrounded side of the coil and the ballast case, which is grounded through the fixture. An arc to ground may result, depending on spacing, carbonization and other factors. The intensity of this arc will be limited only by the line and may, in extreme cases, melt a hole in the ballast case. During advanced stages of carbonization, volatile vapors could be released by the organic materials. If the fixture enclosure will not permit these vapors to dissipate into the room air, they may ignite and explode when the power arc is established.

An effective means of protecting against property damage and possible personal injury resulting from ballast failure is to use a fuse in series with one or both of the line leads of each ballast. While proper fusing affords better protection from a power arc failure than does a thermal protector, it is not a remedy for the results of poor ballast designs, poor fixture designs, misapplications, poor installations or any combination thereof which contributes to the principal cause of ballast failure—excessive temperature. Excessive ballast temperatures can be caused by other factors. An analysis of these will show that, of available protection methods, proper ballast fusing offers the best overall insurance against fixture damage and possible personnel injury due to ballast failures. Proper fusing in either the fixture or branch circuit combined with a thermal protector within each ballast would offer additional protection, but at an expense which probably could not be justified.

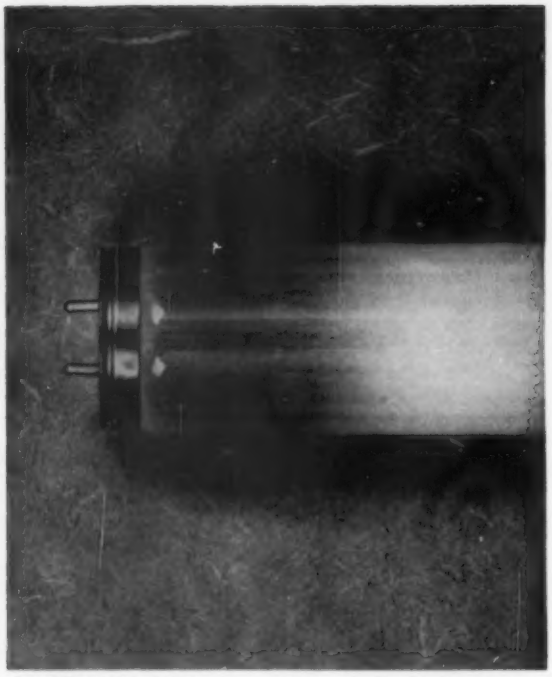
Protective Methods

Methods of protecting against the more common causes of ballast failure are given below.

Overcurrent Due to Shorted Coils

Shorts between windings may result from normal wearing out, misapplication or faulty material. Regardless of cause, under this condition the ballast has failed absolutely. If the condition continues, and the ballast remains on the line, overheating and possible compound or pyranol leakage could result. Proper fusing will provide a positive indication of failure and prevent damage due to internal short circuits. When an automatic reset device is used, which opens because of excessive heating caused by short circuit current, the device resets and power is again applied as the ballast cools following a short circuit condition. Under this condition, a voltage transient could conceivably aggravate the short and eventually result in a violent power arc. Branch circuit fusing will not protect against this condition either, because its rating will not be sufficiently sensitive to detect internal shorts. *Any possibility of an internal short circuit should be protected by a one-time fuse device located within the fixture and applied to each individual ballast.*

Improper installation of fixtures



BLACK LAMP END may be sign of a deactivated cathode which causes end-of-life rectification and excessive heating. Proper ballast protection, planned maintenance and lamp replacement can eliminate a lot of trouble.

INSIDE OF LAMP the deactivated cathode looks something like this.

and misapplication of ballasts also cause premature ballast failure due to excessive heating. Generally, these two conditions will eventually result in failure of one or more of the ballast components. While it is true that a thermal device will warn of such a misapplication, it will do so only at the expense of desired continuous lighting. Certainly loss of light when the thermal device opens is unsatisfactory for the lighting system in offices, hospitals or other public buildings where large scale loss of light could cause panic and injury. *The best protection available against misapplication is to purchase the lighting system through a reliable architect, contractor, fixture manufacturer and ballast manufacturer.*

BALLAST FAILURES result primarily from two causes—deterioration from long usage (12 to 15 years "normal" life) under average conditions for which designed, and breakdown due to excessive temperatures. Millions of ballasts are now in use which are reaching the end of their "normal" life, and an increasing number of failures may be expected due to this cause. Of increasing concern to all segments of the lighting industry are the failures which are resulting from excessive ballast temperatures. These temperatures may be caused by any one or more of a number of reasons. A special Joint-Industry Committee composed of representatives of NEMA, RLM and CBM is conducting tests on CBM ballasts installed in luminaires of varying types, to determine the specific causes of ballast overheating and resultant failures.

Specifiers of fluorescent lighting systems, in the meantime, are logically exploring methods and techniques for providing ballast protection against ballast failures due to excessive heating and other causes. One method has already been described in *Electrical Construction and Maintenance* (August, 1958, pp 76-78). Another method is presented here, including a further analysis and discussion of the many existing problems, as a service to our readers and for the benefit of the lighting industry generally.

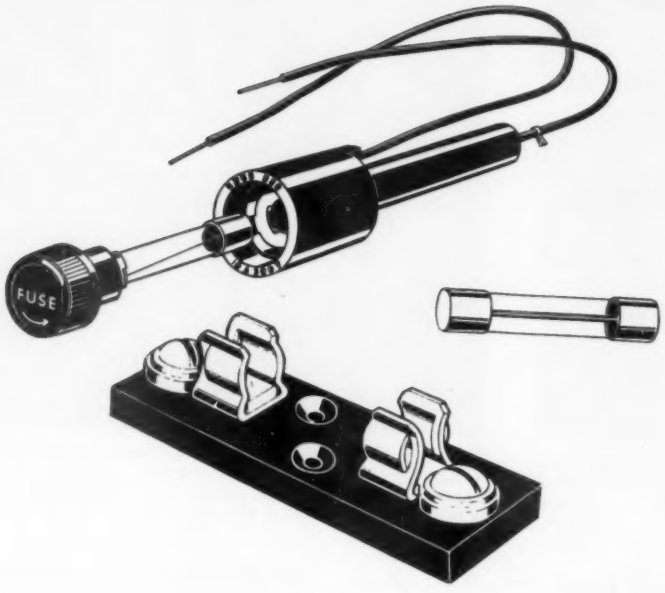
Berlon C. Cooper, *Associate Editor*

Overheating Due to Lamp Failure

When lamp failure results from deactivation of one cathode of the lamp, there is less resistance to flow-of-current in one direction than in the other. This causes end-of-life rectification. Voltage required to sustain the lamp arc goes up immediately upon cathode deactivation. Rapid-start circuits have a distinct advantage over instant-start ballasts—they will not provide sufficient voltage to maintain the lamp arc when a cathode deactivates. Therefore, the lamps go out. The ballast in rapid-start circuits will be unaffected by failure of either lamp due to deactivation.

In the case of instant-start circuits, several different circuits are employed. These must be analyzed separately to best determine what type of protection is most satisfactory.

Single-lamp instant-start circuits providing leading power factor employ a capacitor in the lamp circuit which will not pass dc current. Therefore, a deactivated lamp will not rectify on a lead circuit single-lamp ballast.



TYPICAL FUSE holders and fuses used to protect fluorescent ballasts and fixtures.

Net inductive or LAG circuit single-lamp circuits are still available although the ballast industry has recognized the advantages of the leading circuit. The LAG circuit will allow the lamp to rectify causing excessive heating. Both the *thermal protector and proper ballast fusing* will protect against the harmful effects should excessive heating continue. *Fusing will provide earlier protection against the peak current surges* caused by rectification, and more economically.

Series-sequence instant-start ballasts have been available for a number of years with sufficient electrical and thermal capacity to withstand the excessive heating from lamp rectification. Only one of the lamps in a two-lamp series-sequence instant-start circuit can rectify since the leading power factor portion of the circuit will not permit rectification. In the case of series-sequence, a fuse will not detect excessive heating in the secondary coil since primary current will not increase. Therefore, in series-sequence circuits a *combination of proper ballast fuse and thermal protector properly placed will provide optimum protection.*

To best overcome the harmful effects of lamp rectification on single-lamp LAG and series-sequence instant-start circuits, a planned lamp maintenance program is recommended.

Overcurrent Due to Shorted Capacitor

If the power-factor-correcting capacitor fails, due to a dielectric-failure short circuit, end-of-life or overheating from misapplication, overcurrent as high as twice normal will blow the fuse or open the thermal device contacts. Since the ballast has failed with the loss of the capacitor, it is mandatory that the ballast be removed from the circuit positively. It is possible that the short-circuit arc will be of sufficient intensity or duration to generate a volatile gas from the capacitor impregnant or cause carbonization of the organic insulating materials, likewise producing a volatile gas. This volatile gas can leak from the ballast. If the ballast is unprotected, a sustained arc may ignite the volatile gas and cause a violent explosion. A one-time fuse of the proper rating, which removes the failed ballast from the line instantly and permanently, eliminates this definite hazard. If the ballast cools, power will again be applied and the temperature-sensitive reset device will allow the arc to re-establish again creating conditions for a violent explosion from a power arc.

Proper fusing is the only positive protection against this occurrence which is particularly dangerous in recessed troffer fixtures with glass enclosures.

Recommend Individual Fusing

This analysis of the various causes of failure, the effects of component failure and the means available for protection indicates that proper fusing of each individual ballast, supplemented with a thermal protector in the case of series-sequence instant-start circuits, will provide optimum protection with adequate service. Because a ballast is an electromagnetic and therefore inductive device, slow acting or delayed-action type fuses are recommended. They are less likely to be affected by the high starting surges associated with an inductive device.

Suggested fuse ratings for individual ballasts are shown in the accompanying table. These ratings are based on 110-125-volt operation. Fuses rated at one-half these values should be used for 208-277-volt operation. For best results, fuses should be mounted inside the fixture ballast compartment at least 12 ins. from the ballast.

Keep in mind that the difference in primary currents covering the wide range of normal operating conditions and some types of failure would be very small, or might even overlap. These fuses, coupled with the large increments between standard fuse ratings, make it impractical to fuse ballasts properly for every type of failure. The suggested values in the table should result in circuit clearance before dangerous current magnitudes occur. When investigating lighting installations for trouble, non-rupture of the fuse cannot be considered as positive proof that ballast failure has not occurred.

Analysis of each type of failure clearly indicates that the use of a thermal reset device alone in no way represents a solution to the basic cause of ballast overheating or failure. With the exception of the series-sequence instant-start ballast, where a supplementary thermal device is recommended, proper fusing of the individual ballast is the best positive protection.

To This Long Island Contractor

Housepower Begins at Home

BUILT-IN THERMOSTAT of dining room baseboard heater is adjusted by John Holthusen, electrical contractor of Huntington Station, N. Y. The unit, rated at 1500 watts, is one of ten heaters installed in the main living areas of his home.

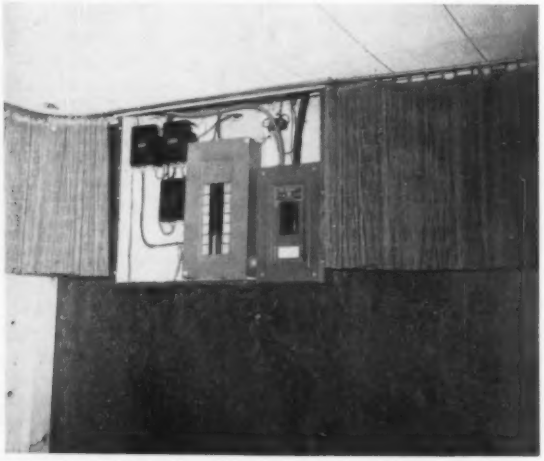
THE OLD story about the electrical contractor who is so busy with his customers that his wife has to call in an electrician to replace a fuse will never apply to John Holthusen, electrical contractor of Huntington Station, N. Y., and past-president of the Electrical Contractors Association of the Township of Huntington, Inc.

This contractor, who planned and built his own home, where he maintains his office, believes in practicing what he preaches—and he sets a good example. Beginning with a liberal 150-amp service, he has installed electric heating, a complete electric kitchen, low-voltage switching, outdoor weatherproof receptacles, multiple telephone outlets, and roughed-in wiring for a fire alarm system, not yet completed.

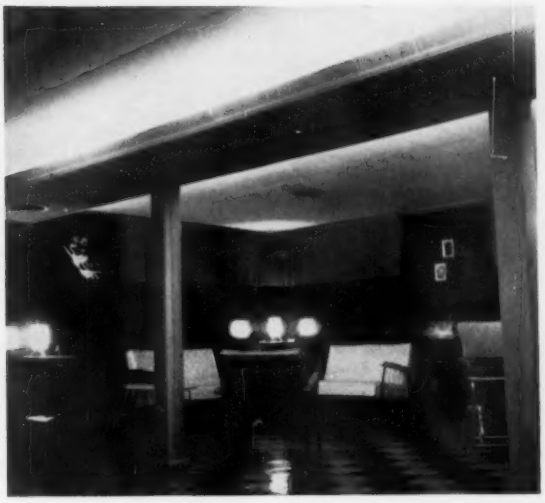
The main service panel, fed by two 1/0 RH conductors with a No. 2 neutral, contains a 50-amp breaker feeding a 100-amp, 16-circuit, general service distribution panel mounted adjacent to the service panel in the basement recreation room; a 50-amp breaker feeding two 100-amp panels, 20 and 6 circuits, located in the basement workshop; and a 40-amp breaker for the clothes dryer circuit. Use of three breaker panels at different locations simplified wiring and reduced length of branch circuit runs. These panels, plus heating system relays, are concealed by bamboo curtains in the recreation room.

The main portion of the house is heated electrically with wall-mounted radiant units: two 1500-watt heaters in the living room, two 1000-watt heaters in each of two bedrooms, and single units in the dining room, bath, kitchen, and third bedroom, rated at 1500, 1320, 1200 and 1000 watts respectively. As a precaution against repetition of total power failures experienced

RELAY PANEL (with cover open) in basement workshop mounts low-voltage relays and transformer for remote switching of lighting and appliance circuits. Schedule on panel cover identifies relays with circuits. Panels with 20 and 6 circuits, respectively, are at right.



MAIN BREAKERS in panel at right feed three sub-panels and dryer; breaker panel in center feeds circuits at this end of house. Relays for low-voltage wall-mounted thermostats used in conjunction with electric heaters in living room, kitchen and master bedroom are at left.



BAR AREA fluorescents (above) in recreation room are concealed behind valance; additional lamps mounted above cabinets direct light up to ceiling as well as down through glass shelves. Remainder of room (right) is liberally lighted with portable lamps, colored fluorescents in ceiling troughs, and down lights.

in the past, a small 80,000-Btu oil burner was installed in the basement to heat the home workshop and basement recreation room. On hand is a 500-watt gasoline-driven emergency power unit to supply current for burner controls, refrigeration and emergency lighting if necessary.

Lighting circuits are controlled by low-voltage relays, installed in a central cabinet near the two distribution panels in the workshop. Maximum use was made of multiple switching, each fixture being controlled from as many positions as necessary to insure a continuous path of light through the house in any direction without the inconvenience of walking through an unlighted room to reach the switch. Included is a switch at the kitchen door to operate the motor-controlled overhead garage door; a switch outside the front entrance controlling the porch light for the convenience of guests and to eliminate the necessity of groping for the door lock in the dark; and a switch in the bedroom controlling a kitchen convenience outlet should it be desired to energize a previously prepared appliance upon awakening in the morning. In addition, a 9-circuit master control in the master bedroom permitting bedside switching of circuits is in the process of being installed.

Liberally spaced convenience outlets in the living and dining rooms are fed by 3-wire circuits to permit individual switching and at the same time provide permanently energized receptacles for applications not requiring remote switching. Three weatherproof receptacles are located in the rear of the house plus two in front, for outdoor lighting and power tool use. A post light at the front of the property provides walkway and driveway illumination. In the kitchen are two 20-amp appliance circuits, plus separate circuits for the dishwasher, oven and range unit.

Phone jacks were wired in the kitchen, living room, bedroom, basement, and patio. A switch at the handset in the basement workshop connects battery power permitting its use as an intercom between the kitchen and workshop.

Also roughed in and in process of being installed is a complete home fire alarm system, with provision for detectors in all rooms plus basement and attic.

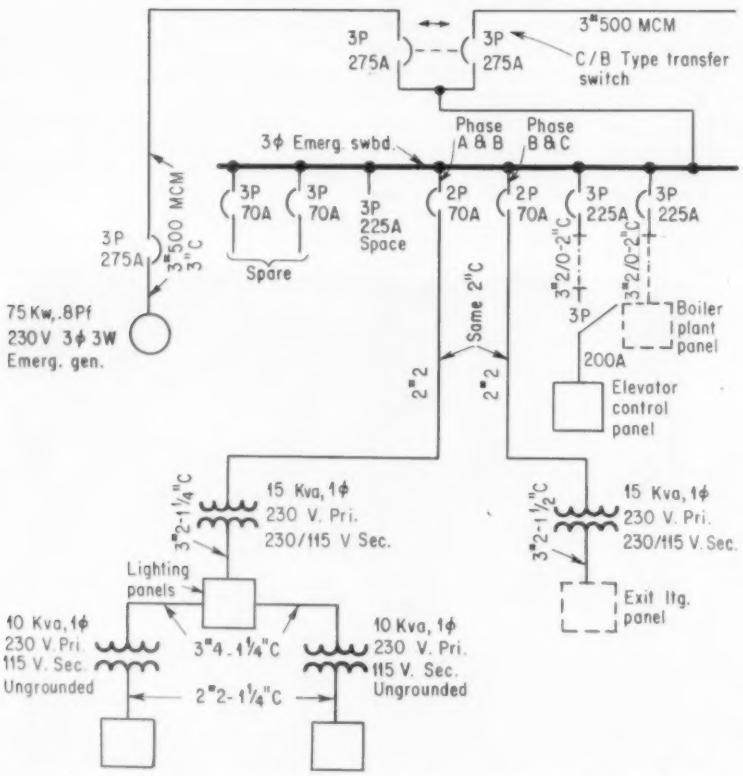
"I did not wire my home as a sales aid," says John. "I just happen to believe in the kind of convenient living I've been trying to sell my customers."

KITCHEN incorporates all-electric major appliances as well as liberal circuit capacity for plug-in use. Low-voltage switches at rear door, visible beneath overhead cabinets, control lights in kitchen, in office area (to left of doorway), and outside rear entrance. Single switch operates overhead garage door.

Hospital modernization includes . . .

Standby Power Supply

How Polyclinic Hospital, Cleveland, Ohio, met the problem of assuring electrical power continuity with a standby diesel generator and automatic throwover control, installed by Parker Electric Company, electrical contractors.

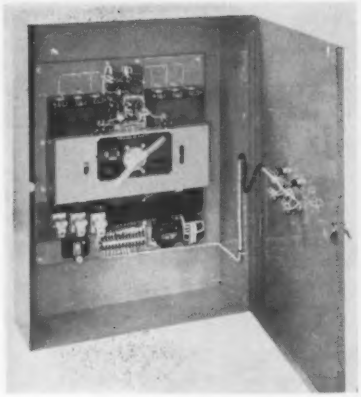


EMERGENCY DISTRIBUTION system consists of normal supply through the circuit breaker type transfer switch to a 3-phase emergency switchboard, an emergency generator connected to the emergency side of the transfer switch and feeders and transformers arranged to assure both emergency lighting and heavy power demands. All emergency loads are supplied from the 3-wire, 3-phase, 240-volt power service.

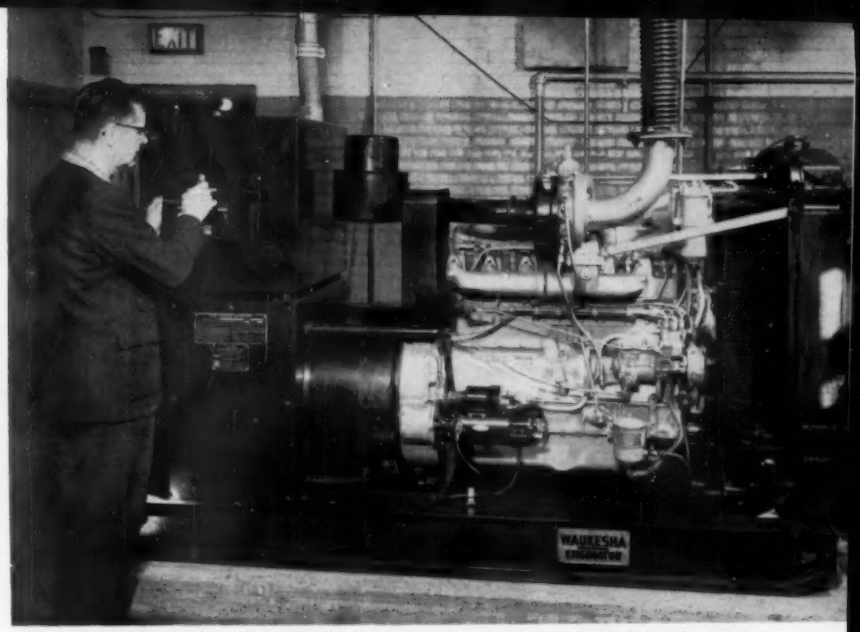
CONTINUITY of electrical power supply—an essential part of modern hospital electrical design—was carefully integrated in the extensive expansion and modernization of Polyclinic Hospital, Cleveland, Ohio. Here, Dalton-Dalton Associates, architects and engineers, utilized an emergency generator and modern control equipment to provide instantaneous transfer of essential loads from normal to emergency supply. The complete power supply system for this 168-bed hospital incorporates a number of features which particularly suit it to hospital application.

In the past, any failure in power from the public utility would have resulted in the hospital's switching over to a municipal standby power system. However, in the event of disaster, municipal power is as apt to fail as the public utility. Thus, Polyclinic planners decided to set up the system for direct transfer from utility to a generator of their own.

The hospital is provided with two normal services. One is of 120-240 volts, 3-wire, single phase for lighting service. The second is 230-volts, 3-phase serving the air conditioning system, elevators, boiler pumps and related equipment. The standby plant with an 80% power factor is



TRANSFER SWITCH contains two mechanically-linked circuit breakers. Transfer is made by means of a universal motor operating through interlocked linkage. Relays hold on normal until the generator is up to full voltage. When switch is in emergency position, relays again hold for 2 to 20 minutes to assure full restoration.



DIESEL GENERATOR is tested weekly by means of a manual test switch on the start cab. Here maintenance engineer Edward Boales is operating the test switch. The fully instrumented control cabinet, including elapsed time and frequency meters, is located over the generator housing. The battery charger and batteries are located behind the generator.

connected into the latter service. Two lighting distribution transformers are used for stepdown to enable the system to be adapted for emergency lighting service.

The brain of this system that stands guard over human lives at Polyclinic is the Trans-O-Matic automatic transfer switch, developed by Lake Shore Electric Corporation of Bedford, Ohio. In the event of normal power source failure, relays in the switch unit automatically actuate the start system for the hospital's standby power plant and transfer hospital load to it.

It was the design objective to provide emergency power for all requirements essential to patient safety. As now set up, emergency power is fed to surgery, obstetrics, emergency room, exit and stairway lights, staggered corridor lights, one elevator serving all floors, fire alarm system, and indicated wall receptacles for oxygen tents and other such devices essential to human life. Further, power is available to the boiler plant so that steam can be maintained through any prolonged main power outage.

The standby plant, a 60-kw diesel generator, is run for a specified time each week to maintain its readiness for any emergency. A toggle switch on the generator permits this test to be made on "manual", independent of the transfer switch. When the test has been completed, the toggle is thrown to "automatic" and the generator start circuit will then be actuated by the automatic transfer switch at any time normal power fails.

A full test of the emergency system is conducted monthly to keep clean those contacts that are used only on emergency power. This is made between 3:30 and 4:00 PM when demands are least critical. Just prior to the test, the hospital superintendent's office is notified and surgery and X-ray are contacted to make certain there is no work in progress.

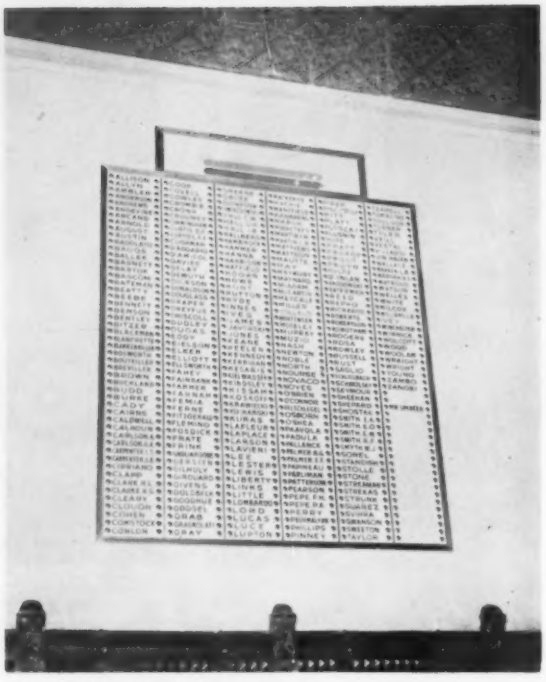
In making the test, normal power from the transformers is cut off by manually tripping the oil switch, thereby simulating an actual power failure. The ATS automatically energizes the start circuit on the diesel generator and, when full emergency voltage is attained, transfers hospital load to it. A unique feature of this switch is the positive-action linkage that operates the two circuit breakers: one on the normal input, the other on emergency. This interruptor permits only two positions—normal closed and emergency open, or normal open and emergency closed; there is no neutral position of the switch. The electric motor of the universal type for driving the interrupter cam is powered from the side to which the load is being transferred.

At the Polyclinic Hospital, power outage will never be more than 10 seconds. It takes only this long, or less, for the engine to start and generator to get up to voltage, at which time load is transferred to it. During real power failure, the switch will return the hospital to the utility source the instant that voltage returns to 90% of normal. However, a time delay relay incorporated in the switch will keep the generator in operation for another three minutes in view of a possible further interruption of service. Thus, the transfer mechanism has a built-in protection against excessive initial loads when normal power is resumed and against sporadic inputs due to a swinging break in power lines.

A feature of the system for Polyclinic provides added protection of critical electrical instruments against excessive damage from serious electrical faults. In the event of sustained normal power overload, the normal breaker in the ATS immediately trips, an alarm sounds, and the load transfers to emergency source in order to maintain power to vital areas.

Automatic Vote Indicator

. . . is installed in Connecticut's House of Representatives, together with accessory bullseyes, photostatic recording equipment and extensive P.A. hook-up.



ROLL OF REPRESENTATIVES, wall-mounted on either side of Connecticut's House chambers, is color-coded to indicate Party affiliations of members, is equipped with red and green bullseyes adjacent to each name to indicate voting action, is topped by rear-projection panel to indicate bill or question being debated, and is spanned by horizontal back-lighted numerical bands that automatically tally and project the final count of each vote.

EACH REPRESENTATIVE'S DESK has a voting lever that may be moved left or right to remotely activate the red or green bullseye adjacent to his name on the wall panels. Occupants of desks also have the use of microphones that may be swivelled on their stands or detached for hand or lapel support. A third button on each desk summons a House page if one is desired.

A COMMENT-provoking innovation in legislative procedure recently has been introduced into Connecticut's House of Representatives in the form of a vote indicator and tabulator that does almost everything except talk back to the speaker.

Focal points of the system are two large wall-mounted panels (one located on either side of the huge chambers room) containing the names of all representatives. Opaque lettering of names is color-coded to designate party affiliations, while flanking green and red bullseyes may be backlighted to designate yea or nay decisions of those voting. The number of the bill being considered or the question before the House is displayed above these name boards on rear-projection panels, while the final count on each issue is indicated on "tote boards" that automatically tabulate the yea or nay bullseyes, then proclaim the result on appropriate horizontal bands.

Since the total number of rep-

resentatives is less than 300, there is no need to provide facilities to indicate a vote total beyond that limit. Therefore the two tote strips on each board contain sequences of figures reading 1212345678901234-567890. This makes it possible to record any vote up to 299. For example, should the count on one issue be 257; the first 2, first 5 and second 7 would light up. Similarly, if another total happened to be 101; the first 1, first zero and third 1 would be illuminated.

In addition to the two wall-mounted boards, a desk-top annunciator is monitored by the House clerk and, when all present have committed themselves to definite yeas or nays, the clerk initiates the operation of the automatic totalizers. So that votes can be permanently inserted into the official House Record, a photostatic copy of the results of each decision is automatically noted on ledger-sized sheets of paper that can be filed for permanent reference. These records are complete, showing names of representatives voting, their party affiliations, the question being voted upon, and the nature of individual votes. The machine producing this copy is located adjacent to the Speaker's rostrum.

Activation of yea and nay bullseyes is by moving small plastic levers to the left or right, as desired. Levers are located on each desk in the chambers. So long as a representative withholds his vote, neither the red nor the green bullseye adjacent to his name will be illuminated. And, until all representatives have committed themselves (or have indicated their desire to abstain from voting), the clerk will delay the final tally.

As may be seen in one of the accompanying photographs, desks of representatives are also equipped with microphones, one being located between each pair of desks. Mikes may be left on their stands and swiveled and tilted as desired, or they may be detached from the stands and held in the hand of a speaker, or they may be clipped to the coat of the one addressing the House if that is his preference. Mikes are equipped with sufficiently long extension cords to permit considerable freedom of movement.

Any representative wishing to voice an opinion or raise a question can indicate his desire to the clerk by pressing a button located on his microphone stand. This button activates an indicating bullseye on a second monitoring annunciator on the clerk's desk. Then, by noting the position of the signalling station and moving appropriate switches, the clerk can connect that specific mike into the amplifying panel of the public address system. At the same time, the clerk notifies the representative that he "has the floor" by flashing a "go ahead" light on the stand of the appropriate mike. PA speakers are located throughout the House chambers, in hallways, caucus rooms and private offices throughout the capitol building. These various speakers may be activated in any desired combination so that the speaker of the moment can be heard in any or all locations as desired.

Still another legislative aid to be found on the desk of each representative is a page button. If any representative wishes the services of a House page, his call is indicated on still another bullseye annunciator, located in the page pen, to accurately inform pages of his desk location.

Credit for the design and installation of this voting indicator and tabulator belongs to Tel-Rad, Inc., and Dukane Sound Systems of Hartford, Connecticut, while credit for adopting this progressive method for legislative streamlining belongs to the state of Connecticut.

DESK-TOP ANNUNCIATOR informs House clerk of representative desiring to use microphone. Adjustment knobs, levers and dials permit panel operator to then connect specific microphone into amplifier, select speakers for broadcasting to various areas in the Capitol building and to adjust the overall volume of the system.

AMPLIFIER RACKS, located in alcove adjacent to House of Representatives, are metal-screen-enclosed except for selection and adjustment dials that may be positioned as desired by the operator in attendance during the session.

MODERN HOME of chicken farmer Hugo Hillstrom is supplied from REA by 3-wire, single-phase drop from pole in left background to rear corner of garage. Large poultry house is shown in right background.

Emergency power plant backs . . .

Electrified Farm Living

Full electrical utilization from a modern wiring system is an operating necessity as well as a convenience in this rural poultry farm.

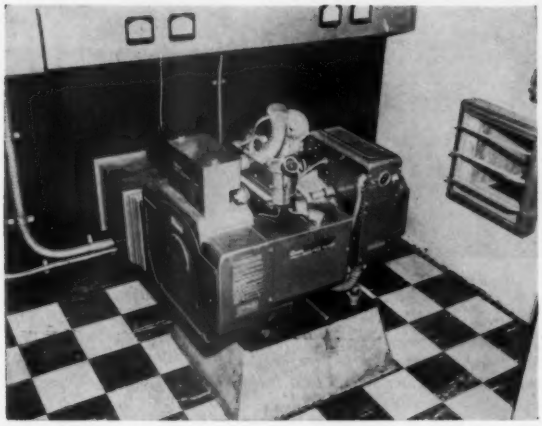
SERVICE MAST on rear corner of garage supports REA drop (coming in from right) which is tapped through large service head to main switch in house. Small mast and service head carries feed up to overhead cable feeder to outlying poultry house. The propane regulator intake and metal exhaust ducting hood for the emergency plant are also shown.

HUGO HILLSTROM of Cokato, Minn., a modern and scientific producer of chickens, is proof that a high standard of living can be enjoyed on farms today through planned electrification. Practically 100% electrified, both in his home and in his large poultry house, Mr. Hillstrom, an agricultural engineer and member of the American Society of Agricultural Engineers, lists the following as practical necessities for comfortable living in rural areas:

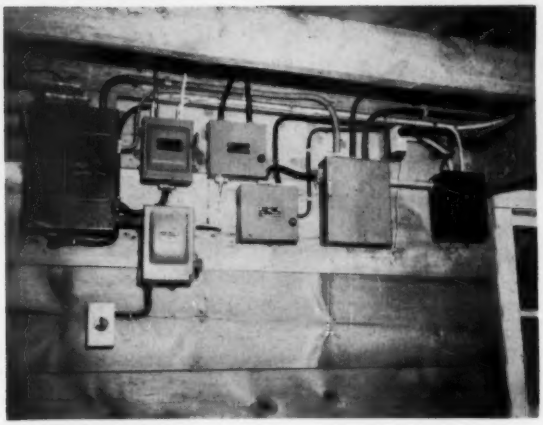
In his home . . . dishwasher, disposal, automatic washer, automatic electric dryer, ironer, flat type (sad iron), 11 cu ft freezer, refrigerator, electric garage door opener, television, three radios, portable dehumidifier, 230-volt well pump, attic fan, kitchen exhaust fan, basement exhaust fan, and miscellaneous electric appliances such as vacuum cleaner, coffee maker, clocks, heating pads, door bells, etc. Three electric fly screens installed on house doors assure almost insect-free country living. A normal lighting load is also included.

In the poultry house, a two-story, 48-ft by 156-ft building for the production of chicks and broilers . . . two feed auger motors (½ hp each), 12 poultry house fans (eight ¾ hp motors, four ⅓ hp motors), 80 15-watt incandescent lights and one electric fly killer.

With this emphasis on all-electric living, Hugo Hillstrom must place more than average trust in his source of commercial electric power. And although the REA from which he purchases his electricity is quite reliable, Hillstrom takes no chances. To take over the vital electrical load (not every appliance is considered necessary) during periods of emer-



EMERGENCY PLANT in garage is a 10-kw, gas driven unit mounted on a concrete block to permit easy inspection and servicing. Air intake louver is at right.



CONTROL PANELS for the poultry house are arranged on a wall. Wiring method is non-metallic sheathed cable. The small white box in the upper right hand part of the picture is a relay to operate the coil circuit in a magnetic contactor (large black box at extreme right) controlling the feed to a panel of circuits for lighting in the pens. A thin sensing wire can be seen leading to the small white relay box. This wire comes from a photoelectric cell mounted near a window in the pen. The sun, therefore, actually turns the pen lights on and off, as needed.

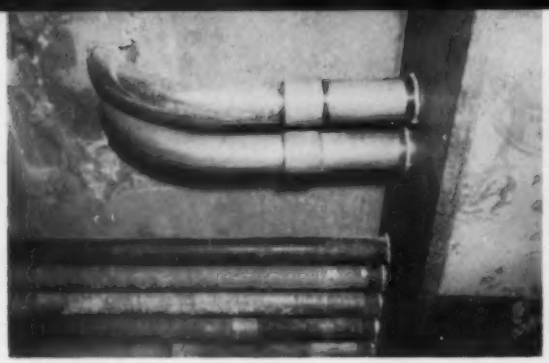
gency, when storms or accidents cut off the electric power, he has installed a 10,000-watt Onan standby electric plant.

The air-cooled, propane-driven generator unit is installed in Hillstrom's garage. It generates 115/230-volt, 60-cycle, single-phase, 3-wire output to meet the dual requirements of both poultry house and dwelling operations. Heated air produced by the engine-driven generator is simply vented to the outside of the garage through a duct.

Should commercial power be interrupted, an automatic transfer panel starts the standby plant and switches the load from outside source to the generator set, all within seconds. When outside power is back to normal, the panel again automatically transfers the load from the generator to the normal supply silently and swiftly.

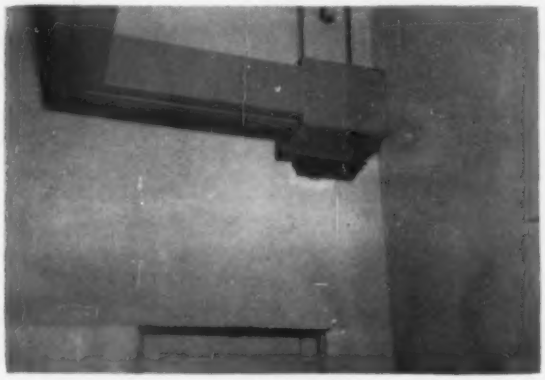
MOTORIZED LOADING of feed by flip of a wall switch is typical of extensive electrical application in poultry house.

ELECTRIC SCREEN insect killer on front door is supplied by cord connection to a ceiling outlet on front porch of Hugo Hillstrom's house. Both front and rear doors and door to the poultry house are equipped with these electric screens.



CONDUIT FEEDERS in the form of two 3-in. conduits (each containing 3-350MCM cables and 1-2/0 RH neutral) run from a new 600-amp main breaker installed in the main switch cubicle to connect with a 600-amp, 3-phase, 4-wire bus duct run that supplies secondary distribution to the maze of surface raceway channels used to repower the hospital.

CLOSE-UP VIEW of the four-story bus duct riser as it is installed in the unused dumb waiter shaft. 10-ft sections of the duct were lowered into the 3-ft by 4-ft opening from the fifth floor penthouse by means of a block and tackle, while an electrician riding a swing-seat in the shaft connected the lengths together as they were lowered and fastened them to the wall.



600-AMP, 3-PHASE, 4-WIRE bus duct feeder for new surface raceway system is shown here as it enters unused dumb waiter shaft through the wall at first floor level of the five-story hospital.

FEEDER TAKE-OFF on each of the four floors is provided by 200-amp plug-in-type switches. The switches are mounted to the bus duct run at the dumb waiter shaft's service door openings which are located in each floor's utility room.

Surface Raceways Repower Old Hospital

. . . satisfying the needs of modern up-to-date electrically operated hospital equipment, with spare capacity included to meet all future requirements.

ST. LUKE'S HOSPITAL of Davenport, Iowa—built less than 40 years ago—found that its original electrical system could no longer take care of its increased use of electricity. A few outlets and circuits had been added but helped little to solve the overall problem.

Leon Bondi, hospital administrator, plus other hospital authorities were conscious of the seriousness of the situation for a number of years, but only after a recent addition to the building was completed which included a completely new service entrance for both units could plans finally be formulated to rewire the existing structure. Tri City Electric Company of Davenport, Iowa, was commissioned to design a new electrical system that would meet present demands, and that would include spare capacity to provide for any and all future needs.

In designing and figuring the job these important factors dictated by the hospital administration had to be given the utmost consideration: (1) The work had to be done without interruption of normal everyday hospital procedures, without causing discomfort to patients by excessive hammering, moving furniture, etc. (2) The installation cost must be as low as possible, and still be consistent with good engineering practices. (3) An absolute minimum of plaster cutting and patching was to be done.

After the premises were closely inspected, it was decided that to add to the existing system would not be feasible. Therefore, a whole new independent system would have to be installed that would not be linked in any way with the existing system. Keeping in mind all of the

SURFACE RACEWAY CHANNELS on each floor run from centrally located utility room down the length of the corridor, mounted on the wall directly below the ceiling. Each run contains three No. 10 TW stranded conductors and one No. 10 TW stranded neutral, which provide branch circuiting for three rooms.

HOSPITAL ROOMS were repowered with surface raceway runs as illustrated here. In most cases the channeling was mounted around the perimeter of the room directly above the floor's baseboard. Also, the installation took place before an overall decorating program got underway, so that repainting will make the metal channeling runs even less obvious.

TYPICAL EXAMPLE of one of four 36-circuit surface type, 3-phase, 4-wire panels that are installed adjacent to service access doors of the shaft containing the bus duct feeder. Each panel is fed by a short piece of 2-in. flexible conduit.

AIR CONDITIONED comfort for any patient who requests it is now available in every room. All four floors of the hospital, or a total of 100 rooms, were completely repowered by more than 5000 ft of metal surface raceway channeling.

above factors, hospital authorities and officials of the Tri City Electric Company agreed that a surface raceway system supplied by its own separate feeders was the answer to their problem.

The job began in the transformer room of the new addition, where the main switch cubicle was housed. Here a 600-amp main circuit breaker was added to the cubicle to control the new system. From this point two runs of 3-in. conduit (each containing 3-350 MCM cables and 1-2/0 RH neutral) connect to a run of 600-amp, 3-phase, 4-wire bus duct just outside the new ambulance entrance areaway. The bus duct proceeds to the basement of the existing structure, where it enters the shaft of an unused dumb waiter that runs the entire height of the five-story building.

Ten-foot sections of duct were lowered into the shaft from the penthouse by means of a block and tackle. An electrician riding a swing-seat in the 3-ft by 4-ft shaft connected the lengths together as they were lowered and fastened them to the wall. Each length of the bus duct was supported every 5 ft by pieces of 1½-in. by 1½-in. angle iron that were bolted to the duct and then lag-screwed to 4-in. by 6-in. timbers recessed in the walls.

Feeder take-off for the surface raceway system is in the form of 200-amp plug-in-type switches. They were mounted to the bus duct run at the dumb waiter shaft's service door openings which were located in utility rooms on each of the four floors. Short pieces of 2-in. flexible conduit run from the 200-amp switches to feed surface mounted, 36-circuit, 3-phase, 4-wire multi-breaker panels that were installed on the wall adjacent to the service access doors of the shaft.

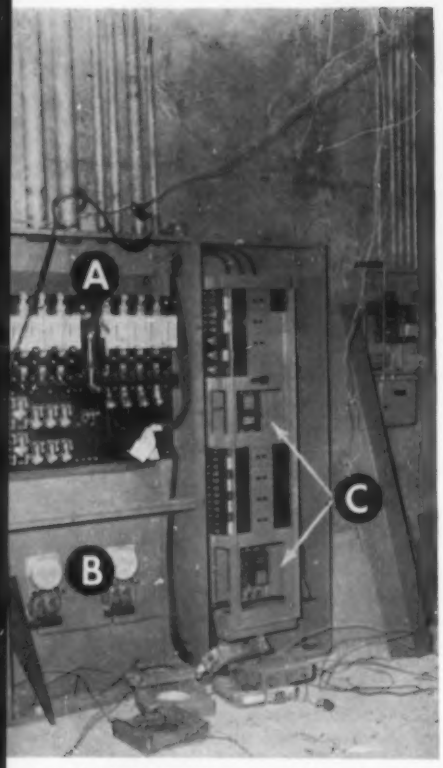
From the new panels short runs of conduit connect to ceiling mounted junction boxes which feed the surface raceway channels carrying the branch circuiting to the rooms. The surface channels run the length of the hospital's corridors parallel to the walls, directly below the ceiling. At each room the metal channel enters the room above the door, follows the doorjamb down to a few inches above the floor's baseboard and continues around the perimeter of the room. Single rooms have an average of three new outlets, one of which is installed beneath a window to provide power to operate a ¾ hp, 110-volt, window-type room cooler. This arrangement of three outlets per room also facilitated furniture and equipment placement to fit any occasion or necessity without losing the convenience of electrical outlets. Individual runs of the metal surface raceway contain three No. 10 TW stranded conductors and one No. 10 TW stranded neutral. Each run of the channeling provides branch circuiting for three rooms, with each room controlled from a separate 30-amp circuit. Over 5000 ft of surface raceway channeling were used to rewire the four floors. The installation took place before an overall decorating program got under way.

Operations activated remotely by . . .

High-Cycle Control

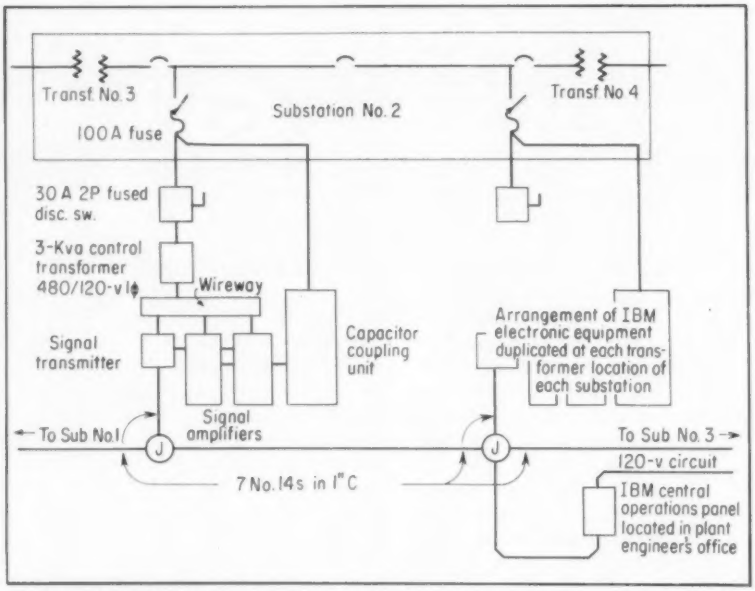
. . . in California plant where electrical installation includes design and construction innovations, photoelectric protective system, and flexible feeder bus-duct arrangement.

By Hugh P. Scott

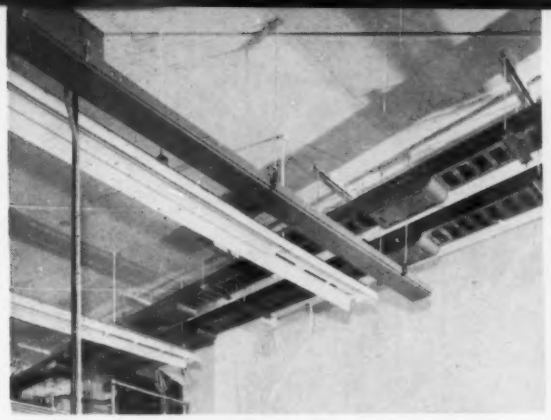


DISTRIBUTION PANEL (related to 480/277-volt circuiting for security, night and corridor lights plus elevator bank in adminstrative building) is equipped with automatic transfer switch wired for selective operation (A); also with full 2-feeder protection consisting of separate phase relays. Switches related to security and night lights (lower bank of breakers in panel at right) are activated by contactors (C) which, in turn, can be controlled remotely from engineer's office by means of high-frequency carrier current plus local dual-coded relays (B).

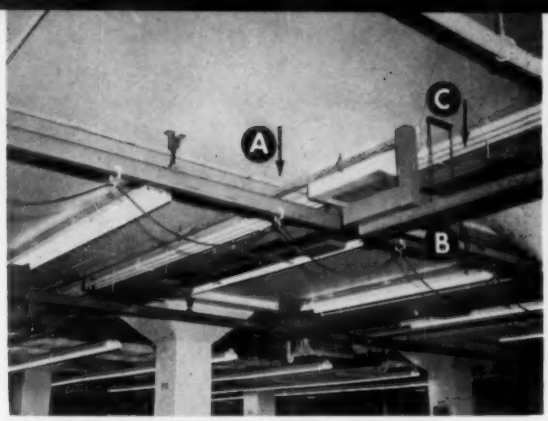
HIGH on the list of interesting west-coast electrical installations is a modern half-million sq-ft commercial industrial structure in Oakland, Cal., recently completed for Marchant Calculators, Inc. Reasons for this interest are multiple: (1) the project reflects numerous unique design ideas and installation techniques; (2) it contains an extensive, flexible busduct distribution network; (3) it is protected against burglary, fire and water damage by a variety of photoelectric and alarm systems; (4) it has a complete, private, automatic, intraplant telephone system featuring dialing-in paging signals, automatic dictation machines and conference connections; (5) it also has an outside telephone system with PBX board for handling in-and-out calls from key personnel; (6) it has motor-control centers for boiler and



SIGNAL-GENERATING equipment, for high-cycle carrier-current control system, is installed at each primary transformer location; connections to the 480/277-volt bus structure being as far removed as possible from the transformer connections and equipped with separate phase fuses to protect amplifiers and coupling equipment. Tube-type transmitters are connected (via JBs and a 7-wire circuit which is common to all six transmitters) to the central operation panel in the plant engineer's office.



HANGERS (for busducts, lighting fixtures or conduit banks) are supported by bolts secured by washers (inserted above and below lips of recessed channels in ceiling) and locknuts. As indicated, hangers may be shifted to any desired suspension line by moving them along the various channels. Recessed channels were positioned on slab forms prior to placement of reinforcing bars and pouring of concrete.



LOW REACTANCE BUSDUCTS (C) are mounted high enough to pass above crane rails, although runs of lower-elevation plug-in busduct (B) occasionally have to be interrupted when crane bays are encountered. In these instances, "leapfrog" connections between plug-in sections are established by means of tap boxes, square wireway stubs and conduit cross-overs (A) that hug ceiling slabs to bypass crane tracks.

air-conditioning chiller equipment, with automatic sequencing; (7) it has automatic step controllers for automatically starting groups of machines in a large line of screw machines, to avoid tolerance errors during warm-up periods; (8) it contains automatic heat-treat and plating equipment; (9) it has an outstanding all-electric kitchen, many excellent lighting details and (10) a plant-wide remote high-frequency carrier-current control set-up.

In connection with this latter feature, numerous operations (such as start-stop control of lighting, motor starters, magnetic switches, fans, pumps, heating devices and unit ventilators) are initiated by high-cycle coded impulses which are superimposed onto the standard 60-cycle distribution system in the building for the purpose of activating relays connected directly to devices or panel breakers so controlled.

Basically, this high-cycle control system consists of (1) equipment for generating a high-frequency signal, (2) a central operations panel, which is the system's source of directional commands, and (3) dual-coded relays that execute those commands.

Signal-generating equipment (located, in duplicate, adjacent to each transformer of each of the three substations) includes 2-pole fused disconnect switches, 480/120-volt single-phase control transformers, signal amplifiers, capacitor coupling units and tube-type impulse transmitters which are connected (via a 7-wire circuit common to all six signal-generating units) to the central operations panel located in the plant engineer's office.

In connecting this signal-generating equipment to substation bus structures, buses are tapped at points furthest removed from transformer connections, while fuses are installed in each phase leg to protect amplifiers and coupling equipment.

The central operations panel in the engineer's office, having the capacity to control up to 38 separate circuits electronically, includes (1) a master clock, (2) programming mechanisms, (3) current inactivating switches for each circuit, (4) a signal-transmission verifier that monitors command impulses to verify their correct coding, (5) circuit-status indicating lights, and (6) manual pushbutton controls to permit instantaneous manual signal transmission to various non-coded receivers.

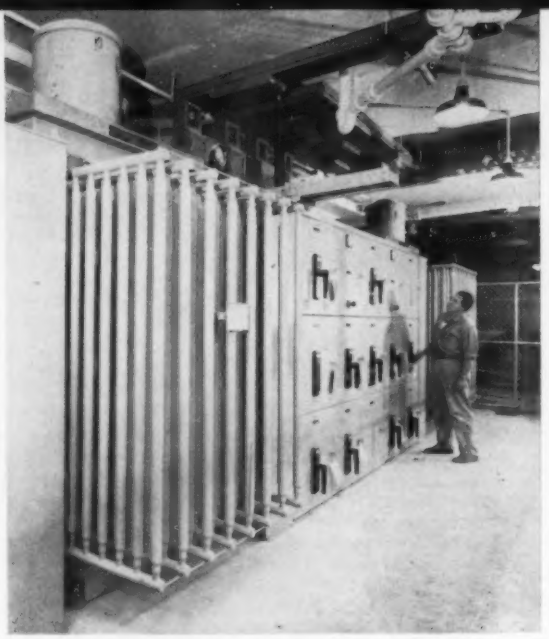
Programming mechanisms in the operations panel are removable-drum minute-interval selection devices incorporating calendar trips to make circuits active or inactive for any desired interval throughout a repetitive 24-hour period.

Circuit-status indicating lights, mounted on the panel's hinged door, show which command signals have been transmitted (either automatically or manually), these indicating lights flashing during the actual transmission of the signals to inform the watch engineer that pulsations are being superimposed onto the distribution system. Manual controls on the panel door also include a circuit-selection switch that designates the desired circuit code, and a cycle switch that starts transmission of either the On or Off pulsations, as desired.

Connected directly to the motors or devices to be controlled by carrier current (or installed adjacent to the related local distribution or control panels) are the dual-coded relays that combine electronic rereivers with electro-mechanical decoding mechanisms which are capable of distinguishing between any one of ten different On or Off coded signals transmitted at the channel high-frequency level for which they are matched, four separate channels operating at 3510, 4200, 5000 and 6000 cycles. When so activated, these relays then act to provide momentary paths for the activating 60-cycle current to close the necessary contacts for executing the On or Off directives. It should also be noted that two circuits in one of the channels are used for clock correction, leaving eight circuits in that channel for utility control. These eight circuits, together with ten of the other three channels, constitute a total of 38 circuits for utility control.

For safety and convenience, load and control switches are also added to these relays, load switches serving as means for manually switching operational units On or Off at the relay position, regardless of the program schedule set up at the central operations panel. These dual-coded relays can also accept individual manually applied command

FEEDER BUSDUCTS serving upper floors rise through apertures in slabs, then are carried laterally at ceiling level. In this installation, lighting and distribution panels related to 480/277-volt utilization are positioned adjacent to busduct risers, while 120/208-volt 4-wire panel (not shown) is served through dry-type transformer mounted directly above it.



ONE OF THREE double-end unit substations that step 12-kv primary to 480/277-volt distribution level. Transformers are self-cooled Pyranol-filled units; primary fusible interrupter switches are key-interlocked with main secondary breakers to prevent opening under load; all main, bus-tie and feeder breakers have draw-out elements.

impulses from the central panel without changing the status of other units which are functioning properly.

The dual-coded relays used in the Marchant building are designed principally for the control of magnetic contactors having maintaining circuits; across-the-line magnetic starters with or without Start and Stop reset pushbuttons; reduced-voltage starters; resistance type starters; and similar devices usually demanding 3-wire control.

To afford protection against large instantaneous blocks of power being placed on the system simultaneously, the system provides that (in event of a utility power interruption), all carrier-current-controlled motors would drop out of service, then remain off until switched on again in gradual incremental steps.

An additional comment pertaining to this control system is that dry-type air-cooled step-down transformers (required to supply 120/208-volt power for certain lighting and receptacle circuits which are electronically controlled) are wired wye-wye in order to permit passage of the IBM high-frequency signals through the 60-cycle distribution system. The high-frequency is generated single phase and is applied between each phase and neutral through coupling capacitors, thereby eliminating high-frequency voltage between phases. If transformers were connected in delta on the 480-volt bus, primaries would receive no high-frequency signal.

Busduct Distribution

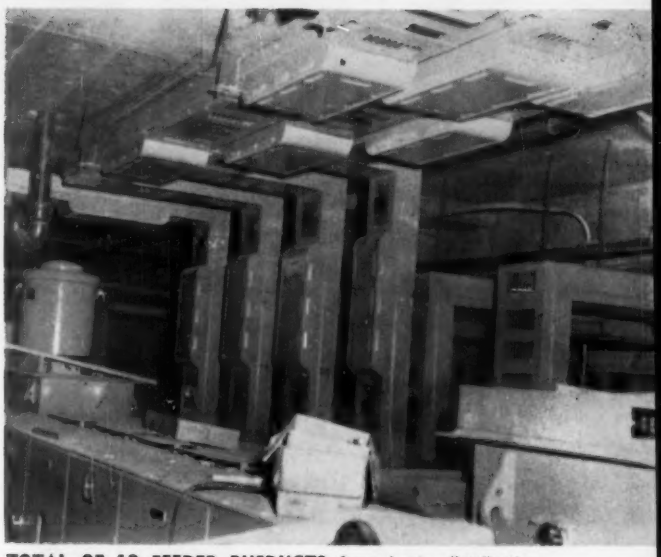
In connection with the extensive busduct system, there are 19 low-reactance 480/277-volt 3-phase 4-bar wye feeders rated variously for either 1350, 1000, 800 or 600 amps, while additional power-distributing plug-in ducts are 480-volt 3-phase 3-bar units rated for either 600, 400 or 225 amps. In the majority of cases, plug-in ducts are connected to feeder ducts or to distribution panels via cables carried progressively through conduits, square wireway stubs and tap boxes. This same arrangement of tap boxes, stubs and conduit is likewise used to connect sections of plug-in busduct together when it becomes necessary to interrupt continuous overhead bus runs in order to bypass or "leap-frog" over craneways (see illustration).

Power for this busduct system is obtained from three basement-based double-end load-center unit substations, two of which are rated at 2000-kva, the other at 3000-kva. At all three substations, primary air-filled fusible interrupter switches are key-interlocked with main secondary breakers to prevent their opening while the Pyranol-filled self-cooled transformers are under load. Main secondary breakers are drawout metal-enclosed units variously operated electrically or manually. Low-voltage bus-tie and feeder breakers are likewise metal-enclosed manually operated units having drawout elements.

Primary power for these substations (12-kv 3-phase 3-wire) is initially brought into the building underground via single-conductor 15-kv paper-insulated lead-covered cables carried in concrete-sheathed asbestos-cement ducts that terminate at an indoor-type primary switchgear assembly where magneblast power ACBs (for mains and feeders alike) are arranged for ac closing and dc tripping (with dc being furnished from a remote-mounted 48-volt battery).

Where it becomes necessary to step current down to 120/208-volt for receptacle use and for some of the lighting circuits, this is accomplished by means of local dry-type air-cooled wye-wye transformers, this wiring combination being required to pass high-frequency control impulses, as previously discussed. In many sections of the plant, this low-voltage current is then distributed to 3-wire

TROLLEY DUCT is used to supply 120- and 208-volt power to assembly benches. Trolleys for power take-off may be moved laterally to any desired location along duct, with conduit drops connecting branch circuitry with points of utilization. Contact between branch conductors and enclosed busbars are effected inside take-off boxes by brush fingers.



TOTAL OF 19 FEEDER BUSDUCTS form basic distribution network for 480/277-volt power in building. Where 120/208-volt current is required for receptacle or local lighting purposes, dry-type air-cooled transformers are installed as needed. These secondary transformers are wired wye-wye to pass high-frequency carrier-current control signals.

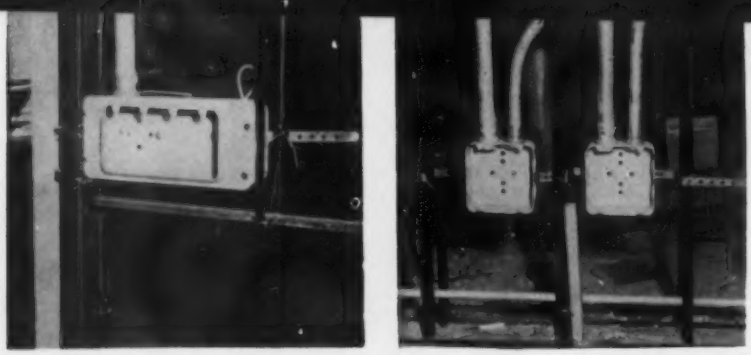
grounding-type convenience outlets through one channel of a 2-duct steel underfloor network (the second channel of which is used to carry wiring related to the telephone and intercom systems). Home runs between underfloor duct JBs and terminal panels are carried in slabs (for 120-volt current) and beneath slabs (for telephone and other low voltage wiring).

Secondary Characteristics

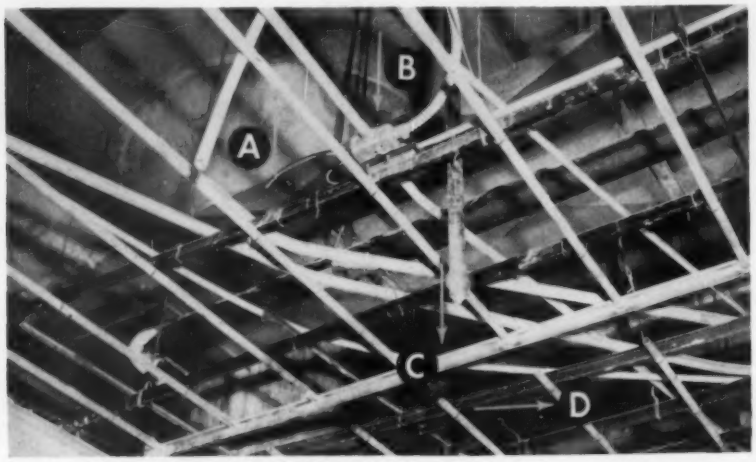
Referring to the secondary distribution system in general: (1) switches in power distribution panels rated 480/277-volt have ability to handle 12 times normal load current and have current-limiting fuses with ICs of 200,000 amps; (2) sub-feeders extend to 480/277-volt convertible ACB panels for 277-volt lighting service; (3) sub-feeds to 120/208-volt convertible ACB panels include wye-wye connected dry-type transformers; (4) sub-feeds between these 120/208-volt convertible panels and related lighting-receptacle panels, also low-voltage busducts, are variously used for incandescent lighting, clocks, signals, receptacles and motorized hand tools; (5) all conduit was tightly corked during construction with standard closed couplings or pennies held by bushings to exclude moisture and foreign matter; (6) conduits are supported variously by trapeze hangers, pipe clamps or metal cleats; (7) sub feeders are generally RH/RW while branch wiring and signal systems subscribe to type TW insulation, (8) minimum size of branch circuiting is No. 12, (9) wire connections are by means of solderless connectors when wire sizes are below No. 6, utilizing bolted-type connectors for larger wire sizes, (10) all cables and conduits are color-coded for positive identification, (11) receptacle and switch boxes in office sections are strapped to steel wall channel joists, with related wiring carried inside the hollow walls through EMT, and (12) many of the basement contact panels, mounted on circular reinforced-concrete columns having flared capitals, are connected to ceiling-mounted distribution mediums via specially-designed inclined wireways (see illustration).

SURFACE-MOUNTED PANEL on circular concrete column is connected to ceiling-hugging distribution conduit bank by means of special wireway that rises vertically to the "break" point of the flared capital, then follows inclined surface of same to liberally-dimensioned pull- and junction-boxes.

In connection with the general subject of control, it is pertinent to mention that motor starters are generally of combination types having De-ion breakers and magnetic starters, with thermal overload elements properly calibrated in accordance with motor nameplate running currents, and with engraved nameplates on all switch and PB stations to preclude errors in motor operation. In locations such as the basement boiler room, roof cooling tower, and administration-wing basement and roof areas, the combination starters are mounted in motor-control centers. Here



SWITCH AND RECEPTACLE boxes in office sections are secured between open steel wall joists by slotted and perforated straps. Related branch wiring is carried through wall cavities via EMT.



RADIANT HEATING AND COOLING for offices and lobbies is provided by hot-or-cold water pipe-and-header grid (A and C) secured to underside of suspended galvanized-steel channel framework. Outlet box (mounted on strap saddle-B), with rigid and flexible conduit connections related to subsequently-installed lighting fixture, is supported by top of same framing members. Aluminum radiant-acoustical panels clip to underside of water pipes to form finished ceiling. In unheated lobby bays, dummy pipes are installed to provide uniform grid for panel support. Zone control for heating and cooling is accomplished by thermostatically-operated circulating pumps.

starters are wired to master terminals where local control relays and electronic relays for remote control are grouped. Equipment at these various locations includes motorized boiler-room auxiliaries, air-conditioning motorized pumps and fans, chiller compressors with auxiliaries and air-handling units and circulating pumps.

At all other locations, combination starters are mounted either individually or as gutter assemblies. At each motor location, jog and lock-stop PBs are provided, the jog PB serving for local tests or adjustments of equipment, and the lock-stop PB serving in lieu of a disconnect switch.

In locations where motors are exposed to water or grease (such as in the all-electric kitchen), motors are completely enclosed, mounted as integral units or contained within the machines they drive. In these cases, local control switches are safety-type, switches and enclosed controllers being mounted on the machines. Where such motorized equipment is in the fractional-hp range, enclosed tumbler switches with overload heaters are mounted on motor frames to serve as switch-starter combinations.

Reference to the all-electric kitchen is by no means a minor illustration of motor application, for this modern installation includes motorized dishwashers, mixers, freezer compressors, vegetable peelers, ice cream cabinets, refrigerators, carbonators and lowerators (as well as two 21-kw ranges, a 36-kw booster heater, 18-kw baking oven, 12-kw fry kettle, 10-kw stock kettle, steam tables and urns).

Another indication of extensive motorized operations (likewise disrelated to direct production of a product) pertains to space heating, cooling, ventilation and air conditioning, for these combined systems involve scores of pumps (for oil, hot and cold water circulation, boiler feed, chemical feed, condensate return), fans (exhaust, air cleaners, dust and fume eliminators) and refrigeration compressors.

Human Engineering

Another interesting electrical fact pertains to maintenance, since, in moving into this new plant, Marchant's 20-man maintenance department had a logical opportunity to review formerly-practiced methods, analyze existing weaknesses, then adjust or change them to more-effectively serve new production equipment, schedules and objectives. In so doing, supervising engineer Douglas Egelston recognized the fact that he was primarily handling people rather than inanimate machines, so he instituted a "human engineering" approach (1) to keep his men well informed concerning operating techniques as well as repair procedures, (2) to "cross train" his men in general assignments as well as in specific or specialized practices, (3) to minimize personnel problems resulting from lack of complete understanding, and (4) to establish a positive communication system in the interest of clarity and general efficiency.

Applying this approach, tentative new or improved procedures are first discussed and evaluated with all parties concerned before they are put into practice, and the results have been most gratifying. For example, several men who formerly resisted new methods are now receptive, cooperative and enthusiastic; some who previously merely followed instructions are now offering constructive and practical suggestions; routine maintenance procedures have been refined; and the department now places emphasis upon "prevention rather than cure".

Lyle E. Patton, EE, designed the electrical system in the capacity of consulting engineer to architect Albert F. Roller, both parties being located in San Francisco. The electrical system was furnished and installed by the California Electric Co., Oakland, with Walter Benson serving as job foreman.

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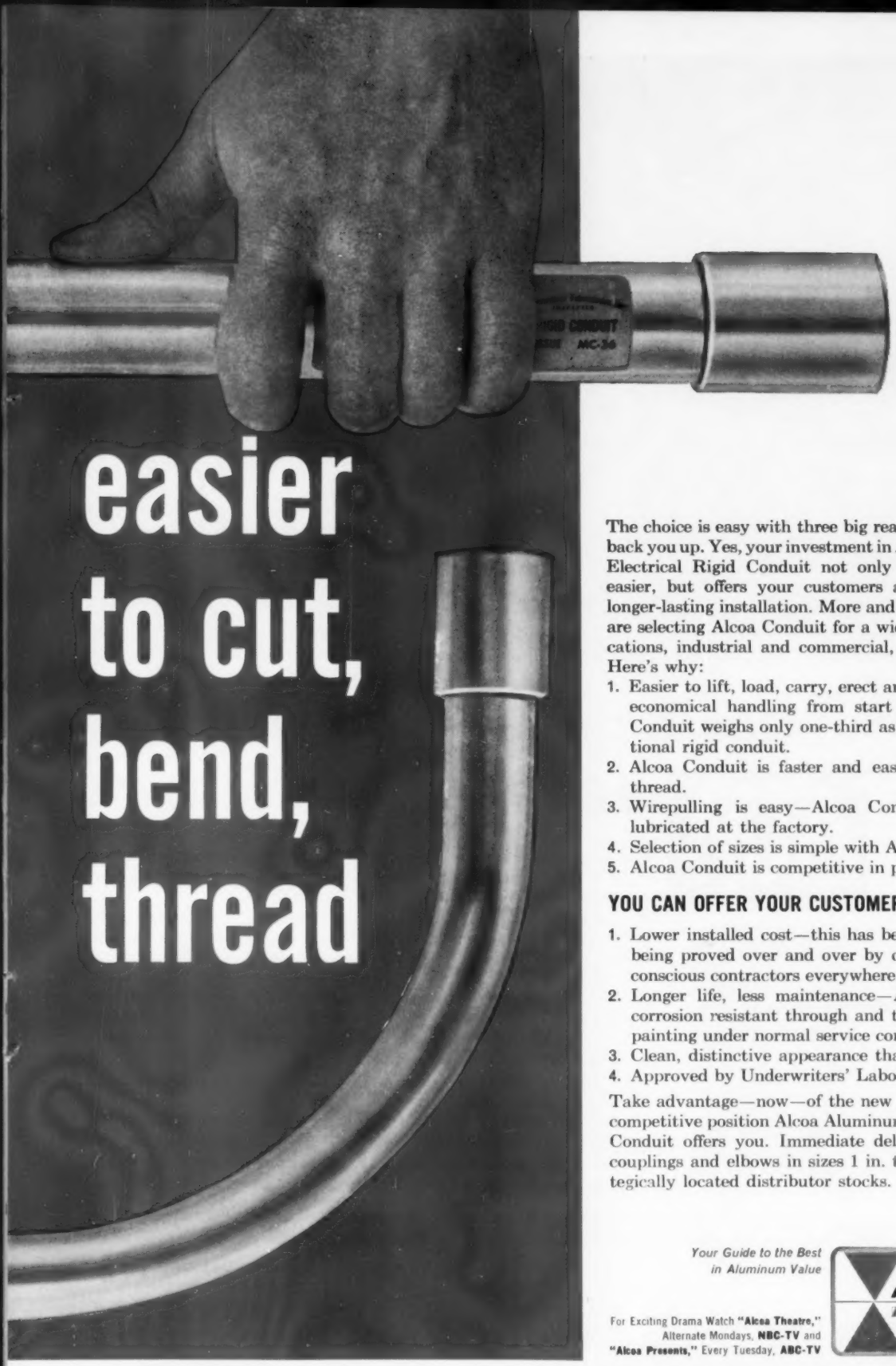

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3. Clean, distinctive appearance that lasts and lasts.
4. Approved by Underwriters' Laboratories, Inc.

Take advantage—now—of the new and commanding competitive position Alcoa Aluminum Electrical Rigid Conduit offers you. Immediate delivery of conduit, couplings and elbows in sizes 1 in. to 6 in. from strategically located distributor stocks.

Your Guide to the Best in Aluminum Value

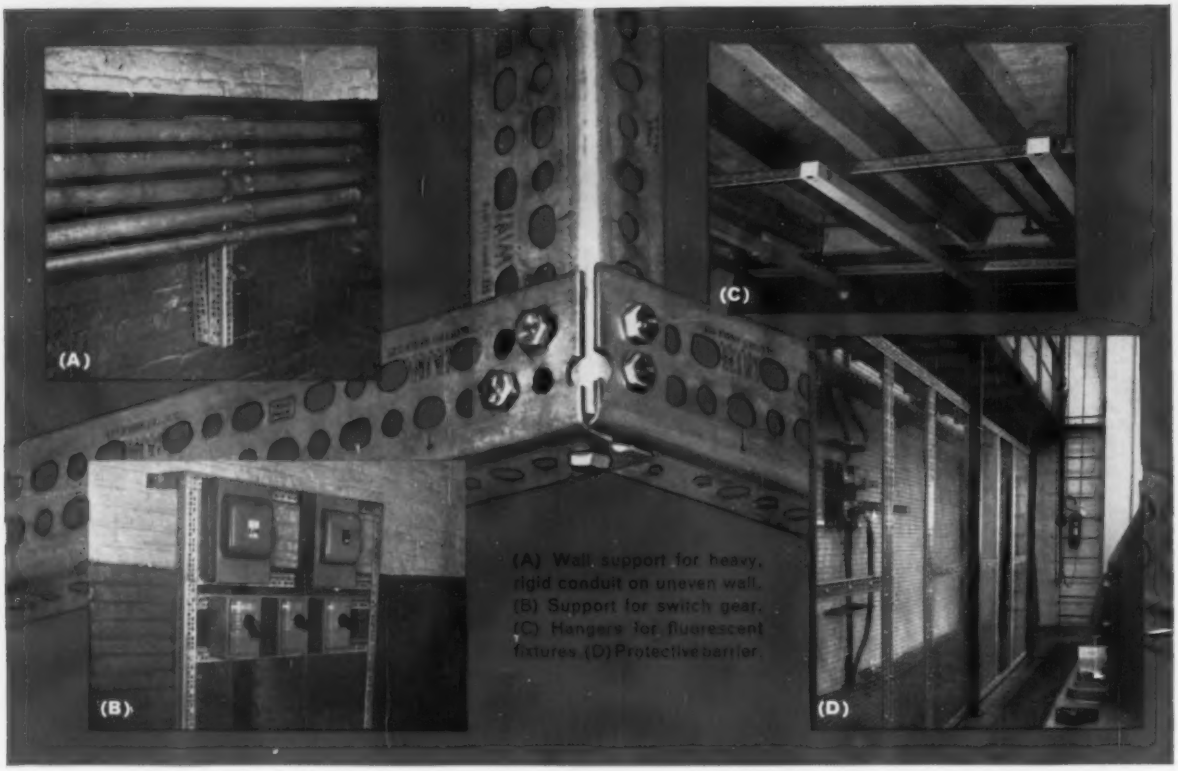
ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

For Exciting Drama Watch **"Alcoa Theatre,"** Alternate Mondays, **NBC-TV** and **"Alcoa Presents,"** Every Tuesday, **ABC-TV**

make GraybaR your shopping center for . . .

GraybaR Everything Electrical GraybaR ELECTRIC COMPANY



(A) Wall support for heavy, rigid conduit on uneven wall. (B) Support for switch gear. (C) Hangers for fluorescent fixtures. (D) Protective barrier.

Cut Costs on Any Job with New AIM® BRAND SLOTTED ANGLE

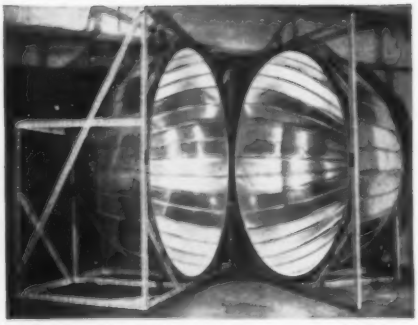
For extra savings on every electrical installation, use versatile, new AIM Brand Slotted Angle—the only framing material that gives you Lock-Joints, Friction-Joints and ⅜" structural bolts.

A new, exclusive, slot-and-hole bolting pattern cuts installation costs, provides durable structural assembly and ease of apparatus attachment. Friction-Joints, easily formed by bolting through the slots, offer good rigidity. Bolting through the round holes gives you Lock-Joints for maximum strength and rigidity. All standard electrical fittings adapt to ⅜" holes; no reaming or special fittings needed.

Save on installation time, handling and storing. And you make an initial saving on material cost.

Cold-rolled galvanized steel, AIM Brand Slotted Angle is available in two sizes: Standard 225-80 (2¼" x 1½" x .080") and Heavy-Duty 300-104 (3" x 1½" x .104"). Packaged in 10 pieces of 10 or 12-foot lengths with nuts and bolts.

AIM Brand Slotted Angle is a product of Acme Steel Company, U. S. pioneers in slotted angle framing material.



New AIM Brand Slotted Angle is adaptable to all kinds of applications, even such an unusual installation as this street light testing device.

'GraybaR Distributed by 'GraybaR ELECTRIC COMPANY

ACME STEEL **AIM Brand Slotted Angle** AIM BRAND

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NEW... From APPLETON

7P SERIES
PLUG-IN REELITE®

EXTENSION CORD REEL WITH HANDLAMP

(No Elaborate Wiring Needed)

Versatile wall bracket . . . full swivel action gives unlimited use from wall mounting. Simply pull pin to remove REELITE for ceiling mount . . . no need to remove entire wall bracket!

Plug In Anywhere!

For ceiling installation, the APPLETON 7P SERIES REELITE has full swivel action to give you light wherever you need it!

Switch from wall to ceiling installation without a mounting change . . . simply hang and plug in!

The new, modern design APPLETON 7P SERIES REELITE with handlamp has the quality features you associate only with APPLETON! Universal mounting bracket . . . beautiful baked hammertone enamel finish . . . hand lamp with shock-proof rubber handle, push-through switch, and snap-open guard: takes 100 watt lamp. The model illustrated (7P2), comes with 28 ft. of 18 gauge 2-conductor neoprene cord. Also available with 25 ft. of 18 gauge, 3-conductor neoprene cord; the extra conductor serving only as a ground.

Positive stop action holds cord at desired length, yet a flick of the wrist causes the cord to coil neatly and quickly into the reel when the job is done!

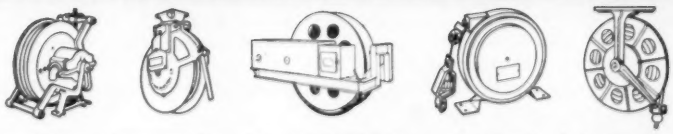
Kink-proof neoprene cord on the new APPLETON 7P SERIES REELITE! Gives you positive protection against oil, grease, and other corrosive elements.

Only APPLETON Makes Reelites

APPLETON ELECTRIC COMPANY • 1734 Wellington Avenue • Chicago 13, Illinois

APPLETON ELECTRIC PRODUCTS®

Also Manufacturers of many other Reelites for Electrical Conductors, Air Hose, Liquid Hose and Weight Balancers.



In all ways, you can't buy better quality than **APPLETON** *. . . the Standard for Better Wiring®*

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Everything Electrical GraybaR

ALL-BRITE
lights San Antonio's
magnificent new
"address of distinction"

YES, 20 STORIES
OF INCOMPARABLE
ILLUMINATION
WITH ALL-BRITE
FLUORESCENT
FIXTURES
AT THE

NBC

BANK BUILDING

Architect: Kenneth Franzheim, Houston. Associate architects: Atlee B. and Robert M. Ayres, San Antonio. Consulting electrical engineer: Dale S. Cooper, Houston. Electrical contractor: Paul Wright Electrical Co., San Antonio. Distributor: Graybar Electric Co., Inc., San Antonio.

NEARLY 2000 PEOPLE WORK BETTER, FEEL BETTER, SEE BETTER

All-Brite Constellaire fixtures, installed throout the new National Bank of Commerce Building, feature LIGHT-STABILIZED injection-molded polystyrene plastic louvers. Result: comfortable 45° shielding combined with beautiful design.

LIGHT OF AMERICAN COMMERCE

how can we help with YOUR lighting problems? Please ask for catalog.

ALL-BRITE FLUORESCENT FIXTURES, INC.
352 SHAW ROAD, SOUTH SAN FRANCISCO, CALIF.

PLANTS ALSO IN LOS ANGELES, SEATTLE, AND VANCOUVER, B. C.
REPRESENTATIVES THRUOUT THE UNITED STATES AND CANADA

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Everything Electrical GraybaR ELECTRIC COMPANY

Photographed underwater at Florida's Silver Springs

Skin-diving demonstration shows what we mean when we say Sealtite flexible conduit is liquid-tight

The new Immersible Motor recently introduced by The Louis Allis Company demonstrated, at the bottom of Florida's famous Silver Springs, its ability to operate completely submerged.

Skin-diving right along with the motor was Sealtite Type E.F. flexible conduit, guarding the electric lines to the power source on dry land. The demonstration dramatically showed that Sealtite remains liquid-tight under unusual conditions.

The tougher jobs that Sealtite is designed for are less dramatic. Standing up under hot sun, rain, sleet, ice, through the seasons is harder. So is shrugging off oils, grease, corrosive fumes, chemicals, salt spray. Yet in mills, mines, process industries, Sealtite quietly keeps equipment operating dependably under conditions that would quickly knock out ordinary conduit.

Want to know more? Electrical Wholesalers stock Types U.A. and E.F.* Sealtite in easy-to-handle cartons or on reels in gray and black. Be certain you ask for and get the quality conduit marked "Sealtite" on the cover. Buy it in long lengths and cut it on the job without waste. Your wholesaler also stocks liquid-tight connectors. Free Booklet S-541 gives you full information on Sealtite. For your copy, write: The American Brass Company, American Metal Hose Division, Waterbury 20, Conn. In Canada, Sealtite is approved by Canadian Standards Association, and sold by Anaconda American Brass Ltd., New Toronto, Ontario.

*Patent Applied For 58188GR

CUTAWAY SECTION of Type U.A. Sealtite shows tough polyvinyl jacket extruded over flexible metal core. Copper conductor wound spirally inside conduit gives positive ground.

Insist on the conduit marked SEALTITE®

FLEXIBLE, LIQUID-TIGHT CONDUIT

an **ANACONDA®** *product*

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'GraybaR Everything Electrical 'GraybaR ELECTRIC COMPANY

NOW YOU CAN OVERCOME THE PRICE PROBLEM

WITH THE *NEW*

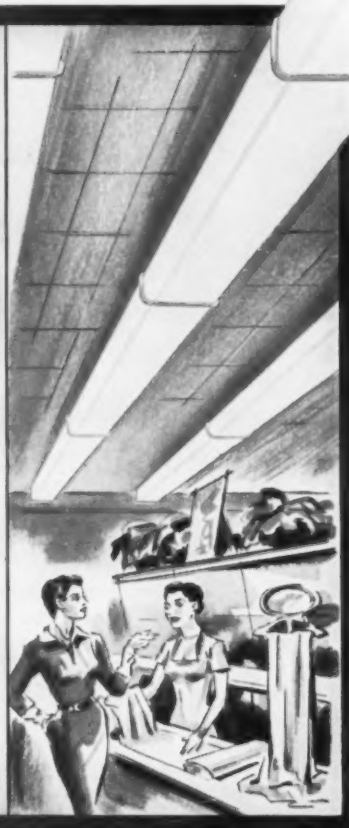
BENJAMIN B_2 BUDGET BEAUTY

- Thrifty initial price.
- Fast low-cost installation.
- Equipped with guaranteed CBM Certified ballast, and UL approved.
- Attractive, stream-lined appearance to fit commercial applications.
- Quality designed. Built by a reliable manufacturer (since 1901).

Available to you for the first time: A thoroughly modern, quality fluorescent fixture for store and general utility lighting, at a truly "limited budget" price. The B_2 offers unusual flexibility in achieving desired lighting levels and choice of arrangements. Your Benjamin Distributor can show you one of these new Budget Beauties. After seeing the B_2 you will agree that it is the sure-fire solution for overcoming the price problem.

NATIONALLY ADVERTISED

Cash in on the interest created with over one and three-quarter million business establishments. Write for the free booklet, "Modern Lighting on a Limited Budget."



BENJAMIN
Electric Mfg. Co. Des Plaines, Illinois
SUBSIDIARY OF THOMAS INDUSTRIES INC.
...always the source of good lighting

Member Eye-Fidelity Lighting Program Sponsored by NEMA

eye-fi RE/LIGHTING

581

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GraybaR Everything Electrical GraybaR ELECTRIC COMPANY

Built to last a house-time

...the new "T"-rated switch from

Bryant

THE NEW BRYANT No. 6001 "T" RATED WALL SWITCH

For economy plus Bryant dependability, try this switch on your next job. It fills the bill for most residential installations. COMPACT—plenty of wiring room. STRONG—built to last a house-time. HANDY—captive mounting screws make installation easy. SAFE—fully enclosed operating parts. STURDY—large yoke with more exposed plaster-ear area. *Available now at your Bryant Distributor.*

Bryant introduces the newest addition to its complete line of moderately priced wiring devices. It's the new Bryant No. 6001 wall switch. Available with brown or ivory handles . . . single-pole or 3-way.

This new switch gives you the Bryant name . . . Bryant quality at competitive prices. Now—more than ever—you can wisely use Bryant on every job you wire.

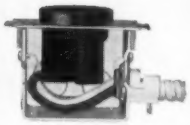
Bryant's broad, complete line of wiring devices is designed to meet the specific needs of contractors and electricians on every job. Faster, easier installation . . . highest quality. And Bryant not only meets but exceeds Federal and Underwriters' Laboratories Standards. Make Bryant first choice . . . there's no need to change brands or distributors from job to job.

See the new No. 6001 at your Bryant Distributor . . . and the complete Bryant line. J-99993-R1

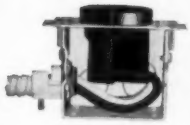
Complete the job with these quality Bryant devices . . . BUILT TO LAST A HOUSE-TIME

No. 5252 grounding duplex outlets.

No. 6142 duplex outlet.



No. 9303 three-wire polarized connector.



No. 9306 heavy-duty three-wire polarized connector.

No. 3830 three-wire polarized cord sets.

The exciting things come from **BRYANT**

THE BRYANT ELECTRIC COMPANY
BRIDGEPORT 2, CONNECTICUT Chicago • Los Angeles

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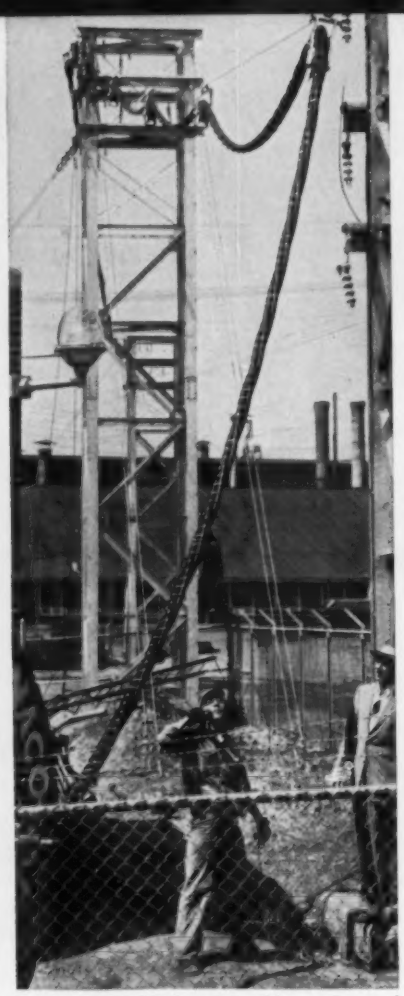
GraybaR Everything Electrical GraybaR ELECTRIC COMPANY

Quickly installed aerial cable. Here's an application where 600-volt Durasheath was quickly installed and easily terminated. Durasheath's neoprene jacket resists weather, abrasion, heat, fumes. Assured: dependable performance and long-range economy!



Factory-assembled aerial cable, made up of 3 single-conductor 15-kv Durasheath cables. Easy splicing, tapping and terminating meant simplified installation in the job shown here. No ducts, crossarms or insulators were needed. Wiring is neat, safe.

Direct-burial cable. The moisture-, oil-, and acid-resistance of Durasheath's jacket makes it the ideal cable for direct-in-the-ground applications like the one shown above. Its flexibility cuts installation time and cost because Durasheath is easy to handle. Its durability cuts maintenance costs!

Look at the ways you can save installation time and cost—with dependable Anaconda Durasheath Cable!

Wherever you want...whenever you want—this versatile power cable lets you install circuits fast... easily... at low cost! Use it aerially... in ducts... underground—in long runs with minimum splicing, indoors or out!

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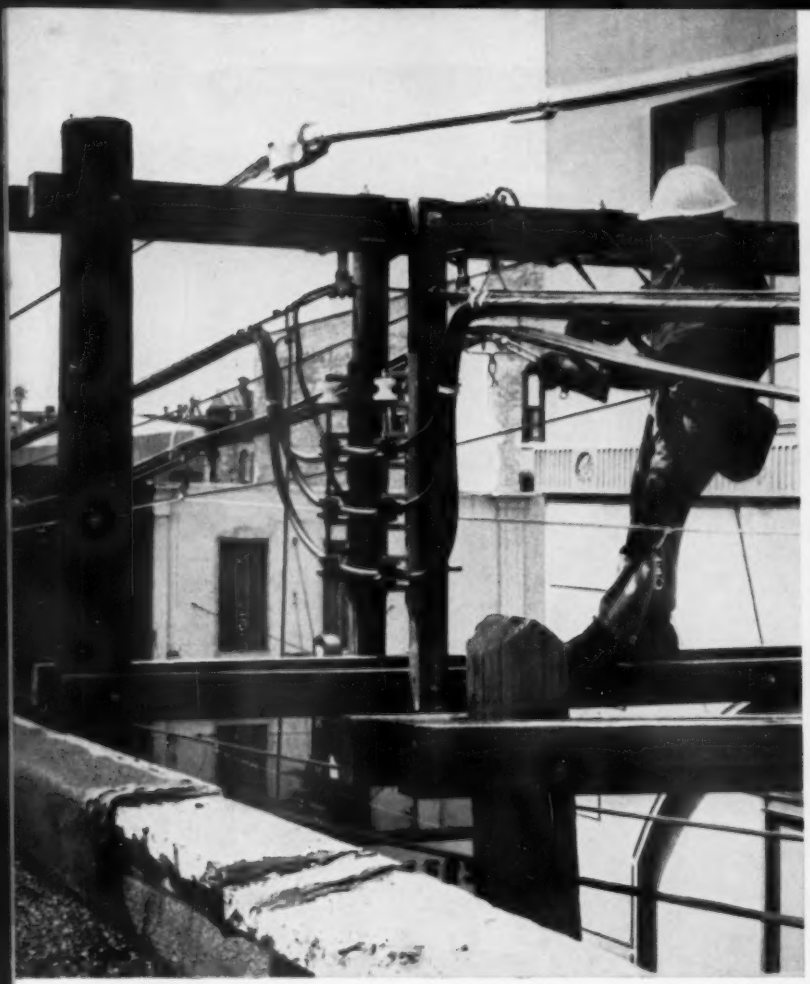

Field-assembled aerial cable. Versatile Anaconda Durasheath power cable was quickly field-assembled into aerial cable with the simple spinning operation shown here. Additional Durasheath was run along the building, grouped in a neat assembly by insulators and straps. It's another example of the way dependable Anaconda Durasheath adapts itself to your power cable needs—whether indoors, outdoors or both. Check into Anaconda Durasheath power cable for your wiring plans!

Installed in ducts. Durasheath's flexibility meant quick and easy installation here. And once installed, its tough neoprene jacket assures long, trouble-free life. Because Durasheath adapts itself to so many uses, your inventory problems are lessened—fewer cables need be carried in stock!

The installations shown above have one thing in common: they're all using Anaconda Durasheath* rubber-insulated neoprene-jacketed power cable —each for a different *kind* of application! Although the above photographs were taken at different installations, they could very well be pictures from one and the same job. Versatile Durasheath is a power cable that can be used to meet almost *any* installation need!

Such versatility in the use of Durasheath enables you to plan the most efficient layout for your wiring – then carry these plans through economically, with assurance of reliability. Talk to the Man from Anaconda about Durasheath. For full information, write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

*Trademark

58376 GR

ANACONDA DURASHEATH ALL-PURPOSE POWER CABLE
Available in all sizes, single and multiple conductor, copper or aluminum, 600 to 15,000 volts and higher.

Insulation. Type RHW, Anaconda ANW, AHW or butyl rubber compounds, each designed for specific purposes.

Jacket. Specially compounded neoprene with high resistance to flame, oil, acids, alkalies, sunlight and ozone. Has high tensile strength. Takes flexing at extremes of temperatures.

SEE THE MAN FROM

ANACONDA®

FOR DURASHEATH CABLE

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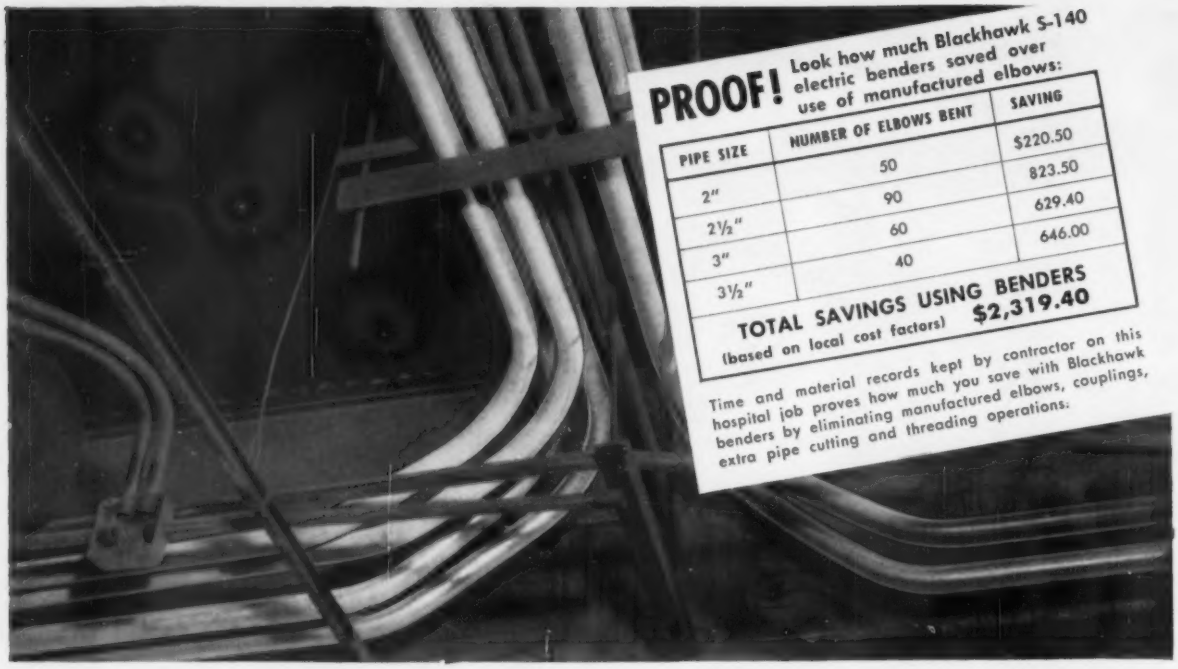

PROOF! Look how much Blackhawk S-140 electric benders saved over use of manufactured elbows:

PIPE SIZE	NUMBER OF ELBOWS BENT	SAVING
2"	50	$220.50
2½"	90	823.50
3"	60	629.40
3½"	40	646.00
TOTAL SAVINGS USING BENDERS (based on local cost factors)		$2,319.40

Time and material records kept by contractor on this hospital job proves how much you save with Blackhawk benders by eliminating manufactured elbows, couplings, extra pipe cutting and threading operations.

$2,319 saved

on one job with "one-shot" Blackhawk Benders

On just one Midwest hospital pipe bending job, this contractor saved $2,319 over the cost of purchased elbows and couplers by using 4" Blackhawk S-140 electrical benders!

Now, thanks to the brand new Blackhawk P-550 2-speed electric pump — your opportunities to save are *even brighter!* Why? Because the new P-550 electric pump teamed with a Blackhawk featherweight aluminum "one-shot" bender cuts bending time to 50% of that required by any other bender! Then you're set for *low-bid, high-profit* business during the coming construction rush!

NEW! super-fast 2-speed pump will break even more records!

- P-550 workhorse is 50% faster than any other electric pump!
- Two-speed action — fast approach to load . . . twice the speed under load!
- *Starts safely* under full load!
- Safest, quietest, most powerful portable electric pump on the market!

Ask for TRY-BEFORE-YOU-BUY Demonstrator Kit!

Here's your big chance to try a "one-shot" Blackhawk bender and P-550 pump on-the-job. A golden opportunity to compare before you buy . . . to actually see how much more profit you can make on *every* job. You pay as you profit! Many distributors are offering interest-free extended terms . . . up to six months to pay!

BLACKHAWK®

BLACKHAWK MFG. CO., Dept. H-2029, MILWAUKEE 46, WIS.

"World's Most Complete Line of Hydraulic Tools"

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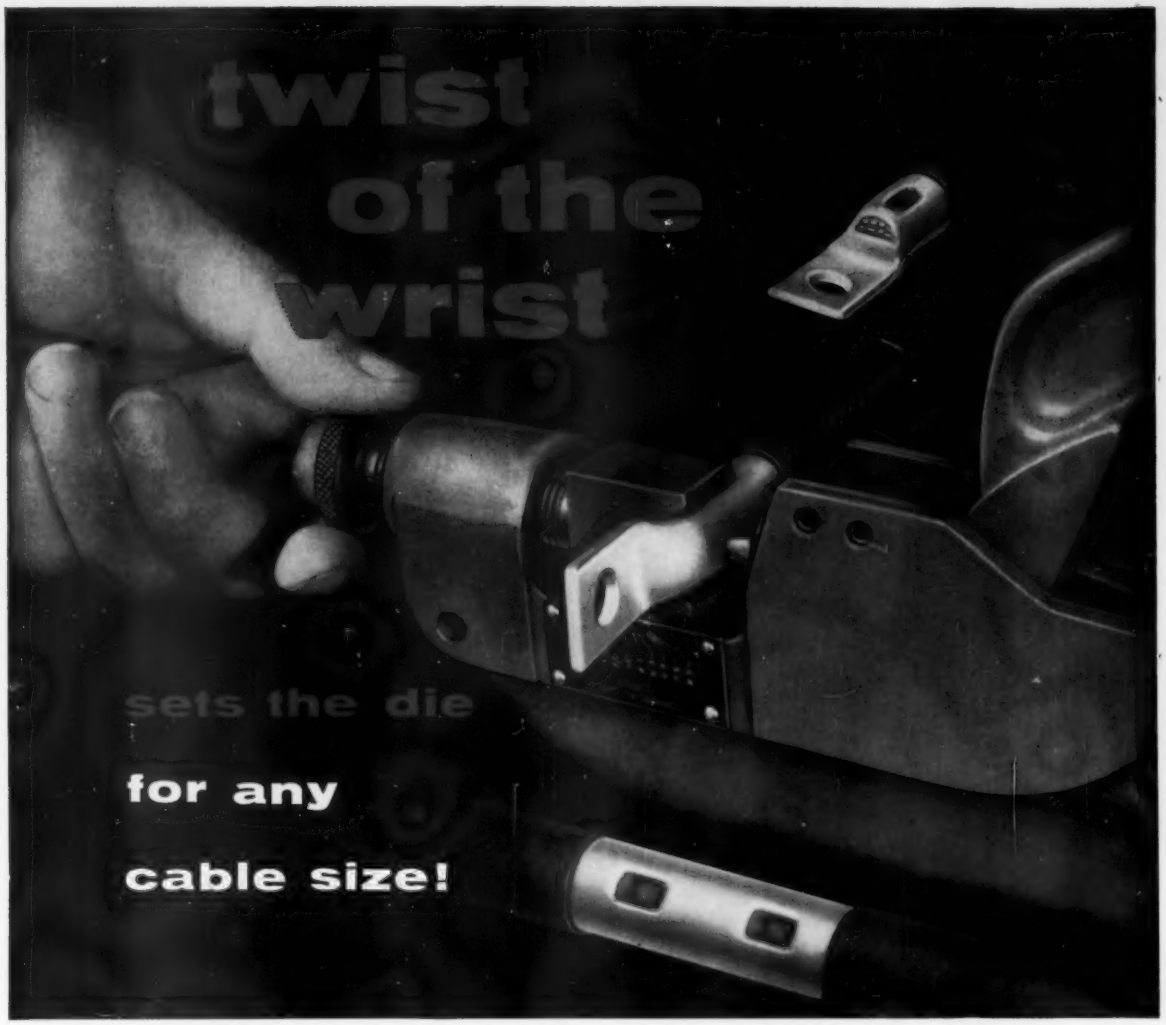
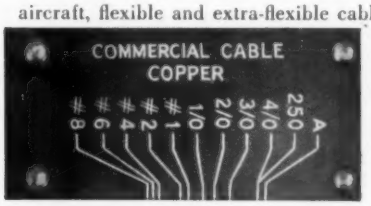


MY29-3 HYTOOL connects copper and aluminum...without changing dies!

No die inserts to change . . . to identify . . . to store or mislay! A twist of the wrist, and you're ready to connect *any* of the wire sizes #8 thru 250 copper . . . #8 thru 4/0 aluminum . . . with a single stroke! The cable-size scale (below) positions the nest die for copper. An aluminum scale on reverse side of tool doubles its versatility. MY29-type Hytools also install mining, aircraft, flexible and extra-flexible cable, and other special conductors. This rugged, lightweight tool is inexpensive, too



only... $36.00

Ask your Burndy distributor for a demonstration.

BURNDY

Norwalk, Connect. • Toronto, Canada

56-23

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Everything Electrical GraybaR

BIDS ALWAYS "ON THE NOSE" WITH UNIVERSAL LIGHTING DUCT

Exclusive BullDog features mean faster, easier installation that keeps costs competitive

Nothing makes it harder to figure lighting bids (particularly pipe and wire) than those unexpected—and expensive—changes you always run into after the job is started.

BullDog 20-amp Universal Lighting Duct licks that problem completely. You know in advance your final material and labor costs. So you can figure estimates—and profits—right "on the nose" before the job begins, instead of after it's over.

Changes in lighting arrangements during installation present no problem since you can tap in anywhere along the entire length of Universal Lighting Duct. Moving outlet locations, or rearranging the layout, can be done without costly and time-consuming rewiring. With BullDog, you just move the exclusive "twist-out" plug to the desired new location in a matter of seconds.

ULD is actually less expensive to install than pipe and wire, too, because it offers so many time-saving features . . . such as prefabricated parts . . . easily joined sections . . . choice of five installation methods . . . and the fact that it both feeds and supports the fixtures, thus eliminating the need for extra supports.

Join the growing list of contractors making money — and keeping customers happy — with ULD. For details, write BullDog Electric Products Co., Detroit 32, Michigan. © BEPCO

BULLDOG

BullDog Electric Products Company, Division of I-T-E Circuit Breaker Company, Detroit 32, Mich. *BullDog Export Division:* 13 East 40th St., New York 16, N.Y. *In Canada:* BullDog Electric Products Co. (Canada) Ltd., 80 Clayson Rd., Toronto 15, Ont.

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SOLDER CONNECTIONS	LOOSEN RUSTED TERMINATIONS	SPLICE CABLES
MAKE RADIO REPAIRS	**MELT LEAD**	**BEND CONDUIT**

THE BERNZ-O-MATIC MASTER PROPANE TORCH

Do these and many other jobs FASTER...EASIER...

and more economically with Instant Lighting BERNZ-O-MATIC® MASTER TORCH with disposable propane gas cylinder

No longer do you have to worry about bulky tanks, tangling hoses, fuel spillage, pumping and priming torches.

Now, you can have a lightweight torch that you can easily carry about in your pocket or tool case . . . or clip to your belt for pole work.

The Bernz-O-Matic Master Propane Torch offers you a host of other advantages. It lights instantly . . . even at 30° below zero. It has a disposable propane gas cylinder that contains enough fuel for months of normal use. When the fuel is exhausted, simply throw the cylinder away and replace with another for the low price of $1.94 (retail). The torch itself retails for only $6.95.

There's another advantage to the cylinder, too. It seals itself, permitting you to change burners at any time during the life of the cylinder.

SPECIAL NEW TORCH KIT

KIT INCLUDES:

NEW CARRY-ALL TORCH KIT WITH FREE METAL CASE . . . gives you all the accessories you need to do virtually any job

BERNZ-O-MATIC PROPANE GAS TORCH with pencil flame burner unit and disposable fuel cylinder (pictured above).

Utility Burner Head for larger jobs

Soldering Tip ideal for electrical work

Flame Spreader for paint burning

Flint Sparklighter

Plus **FREE** lifetime metal carrying case

A $12.20 VALUE FOR ONLY $9.95

"Always Reliable" **OTTO BERNZ CO., INC., Rochester, N. Y.** "Since 1876"

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"GraybaR Everything Electrical" GraybaR Electric Company

FOR VOLTAGES UP TO 600...

There's a *Safe and Dependable* BUSS Fuse or FUSETRON Fuse to fit the needs of every user

If you want Plug Fuses . . .

Use BUSS Clear Window Plug Fuses

Their one-piece body and "safety" design guarantees protection.

They are most convenient to use too, because real big windows and white backgrounds permits entire fuse strip to be seen. Even in poor light a blown BUSS fuse is easy to find.

Ask for BUSS Bulletin WUS

If you want to make safe protection REMAIN SAFE as well as REDUCE blowing fuses . . .

Use BUSS Fustats (have Type S base)

FUSTATS like Fusetron Fuses have a dual-element and therefore, stop needless blowing — and they do more.

They have a type S base that prevents anyone from replacing them with a penny or substitute — or using a size too large to protect.

FUSTATS fit standard plug fuse holders by means of an inexpensive adapter that locks in place and needs never to be replaced.

Ask for BUSS Bulletin SCPS

If you want to reduce blowing of Plug Fuses . . .

Use FUSETRON dual-element Plug Fuses

FUSETRON Plug fuses protect like ordinary fuses against short-circuits and overloads — but unlike ordinary fuses they won't blow on motor starting currents or other harmless overloads.

They are the type of fuses recommended in the 1953 National Electrical Code.

Ask for BUSS Bulletin TCPS

To protect motors and apparatus of voltages up to 125 against burnout . . .

Use 0 to 14 amperes BUSS Fustats

A FUSTAT of the proper size installed to handle only the motor current will reduce to a minimum the chance of a motor burnout from an excessive over-current. In like manner it will protect solenoids, coils and transformers against burnout.

FUSTATS have the same degree of Underwriters' approval for both motor-running and short-circuit protection as the most expensive devices made. They give all the protection it is possible to obtain with any device on the market.

Ask for BUSS Bulletin SMPS

FUSES! . . . THE SAFEST AND MOST DEPENDABLE PROTECTION YET DEVISED!

A fuse has just one vital part — a thin narrow strip of fuse metal. When the heat of a short-circuit is applied, the fuse link must melt and open the circuit.

The high speed operation of the fuse reduces to a minimum the danger of short-circuit damage to wiring and equipment.

Fuses offer dependable protection over the years.

The fuse link is sealed in. Dust can't get at it. Corrosion or oxidation can't increase its capacity or lengthen its blowing time.

There are no hinges, pivots or contacts to stick or get out of order.

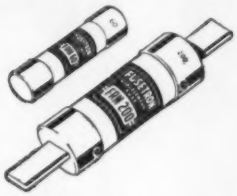
Millions of fuses have been in operation 30 years or more, because there has been no trouble on the

Play Safe! Install BUSS Fuses or

make GraybaR your shopping center for...

If you want fuses that — abolish all needless blows, stop overheating in panels and switches, protect motors against burnouts . . .

Use FUSETRON dual-element Fuses



With rare exceptions, ordinary fuses or circuit breakers do not protect except against short-circuit but FUSETRON fuses provide TEN POINT protection.

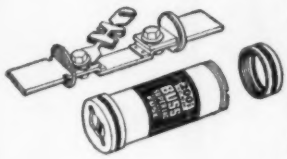
1. Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

FUSETRON duel-element FUSES save you time and money because they are made to PROTECT — not to blow.

Ask for Bulletin FIS

If you want Renewable Fuses . . .

Use BUSS Super-Lag Renewable Fuses



The big advantage of these fuses over all other renewable fuses comes from the prevention of useless interruptions of service caused by needless blows.

The reason for this performance is found in the design of the fuse-case which assures good contact on the fuse link, even if the fuse is renewed by an inexperienced person — and by the time-lag built into the link that prevents the fuse from opening on motor starting currents or other harmless overloads.

Ask for BUSS Bulletin RCS

If you want SAFE protection on loads above 600 and up to 5000 amps . . .

Use BUSS Hi-Cap Fuses

On voltages up to 600, high speed operation on heavy shorts limits current to safe values. This minimizes damage to equipment and cuts down dangerous stresses on transformers.

Ask for BUSS Bulletin HCS

To limit fault currents to very low values . . .

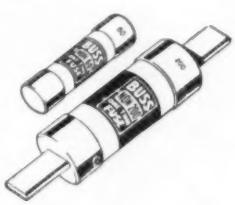
Use BUSS Limitron Fuses

The extremely fast opening characteristics of these fuses prevent heavy short-circuit currents from building up under fault conditions.

Ask for BUSS Bulletin HLS

If you want Non-Renewable Fuses . . .

Use BUSS One-Time Fuses



They save you time and trouble because they get the same engineering care in manufacture as do all products carrying the BUSS Trademark.

Every BUSS One-Time fuse can be depended upon to operate as intended under all service conditions.

Ask for BUSS Bulletin NCS

For protection of TV, Radio, Instruments, Radar, Avionics and Electronic Equipment . . .

Use BUSS and FUSETRON Small Dimension Fuses

A complete line is available. Made in Dual-element (slow-blowing), Renewable and One-Time types in sizes from 1/500 ampere up.

And there is a companion line of BUSS Fuse Clips, Fuse Blocks and Fuse Holders to take them.

Ask for BUSS Bulletin SFB

circuits they are protecting and therefore no occasion to open.

Yet, after years of inactivity, you can be sure the fuse will give the same safe, dependable protection if called upon to open as it would have on the day it was installed.

When Fusetron fuses do blow, there is no recalibration needed. As quickly as the fault in the circuit is corrected, you slip in a new fuse that has been CALIBRATED AT THE FACTORY BY ENGINEERS — a fuse that is as safe and dependable as the one that blew.

Fusetron Fuses Now! THROUGHOUT THE ENTIRE ELECTRICAL SYSTEM

FOR MORE INFORMATION ON BUSS AND FUSETRON FUSES WRITE TO BUSSMANN MFG. DIVISION McGRAW-EDISON CO. ST. LOUIS 7, MO.

FUSETRON

TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION

BUSS

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GraybaR Everything Electrical GraybaR ELECTRIC COMPANY

Coffing Hoists for Safety and Economy

Coffing Quik-Lift Electric Hoists

New coil chain line features push-button controls on all models. Made with lightweight aluminum castings, they are available in 20 models ranging from ¼ to 2 tons in capacity. For other lifting speeds and larger capacities, we offer the Quik-Lift Series "S".

Super Power Coil Chain Hoists

Compound lever and ratchet-and-pawl construction make them lightest, safest, most efficient hoists in their class. Six models in capacities from 1½ to 5 tons—1½ and 3 ton in aluminum as well as malleable iron.

Safety Pull Roller Chain Hoists

Ratchet-and-pawl construction assures safe operation, and "Safety Valve" handle gives before any load-bearing part can fail—warning operator. Ten models in capacities from 1½ to 15 tons.

Challenger Spur Gear Hoists

Light-weight and dependable, the Challenger is available in ½ and one ton capacities. Durable construction and sealed-in lubrication reduce maintenance costs to a minimum.

Mighty-Midget Pullers

Light and compact—500 pound model weighs but 6½ pounds, 1000 pound model but 9½. Handle can be used either as a lever or a high speed crank.

Duff-Norton Jacks Save Time, Energy and Money

Pole-Pulling Jacks

Duff-Norton pole-pulling jacks will pull or straighten utility poles without laborious digging. Hinged channel base permits jack operation at an angle or upright as required. Service need not be interrupted when these jacks are used.

Cable Reel Jacks (single action)

Jacks are equipped with adjustable cable reel lift incorporating a steel hook which can be placed at any point on the lifting rack. Reels of different diameters can be picked up at any height. Five ton model 524MCR is especially adaptable to warehouse use for handling cable, wire, hemp rope, leather belting and the like.

DUFF-NORTON

Duff-Norton Company

MAIN PLANT AND GENERAL OFFICES: PITTSBURGH 30, PA.

CANADIAN PLANT: TORONTO, ONT.

Coffing Hoist Division • DANVILLE, ILLINOIS

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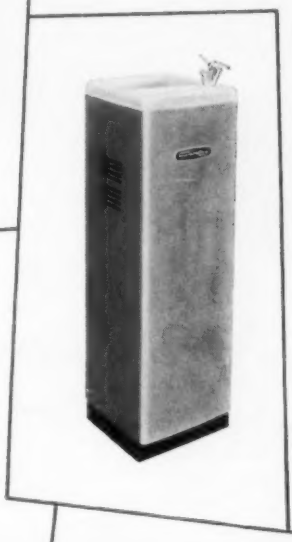
Cordley
Standard "C" Models

7 different units—air cooled, water cooled, explosion-proof. Dual hand and foot controls are failure proof, operate mechanically. Also special low-height model. Coolers available in capacities up to 27 gallons per hour.

Cordley Compact Water Cooler

Where space is at a premium, in stores, small plants and schools, this model gives big cooler capacity—yet takes just one square foot of floor space. Also available in bottle type.



Cordley Remote Coolers

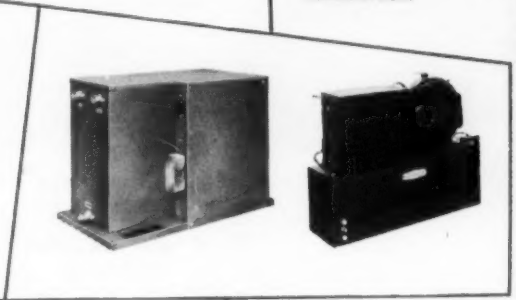
6 models, 4 air-cooled, 2 water-cooled, deliver from 6 to 23 gallons per hour to remote fountains. One cooler serves several fountains. Special "Wall-Hide" cooler is only 6¾" deep — fits into modern, hollow-wall construction.

specify

the best water cooler for the job...

from the complete line of

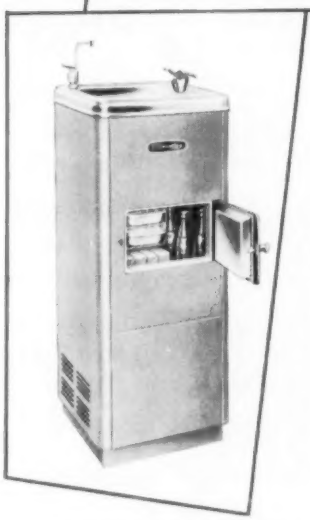
Cordley COOLERS



There's a quality-built and guaranteed Cordley Water Cooler for any drinking water need. For industrial, commercial, recreational, educational and medical use, you can specify the Cordley Cooler that fully meets your budget, space, location, and capacity requirements.

THE FAMOUS CORDLEY FIVE YEAR GUARANTY

A new cooler will be supplied if a defect occurs in the hermetic factory-sealed refrigeration system or cooling tank and freight will be paid both ways within continental U.S. Many other parts also protected for 5-years in this unique guaranty. (Copy supplied upon request.)



Cordley Hot and Cold Water Dispenser Model HCH-5 with refrigerator compartment

All the refreshingly cooled drinking water you need plus enough piping hot water for sixty cups per hour of hot coffee, tea, etc. Here's the answer to the "coffee-break" problem. Employees can quickly make the hot drink they prefer, right in their work areas. Storage compartment keeps drinks and lunches, drugs and biologicals at refrigerator temperature. Freezes two trays of ice cubes. Also available in bottle type.

Ask your Graybar representative to give you full details on the Cordley line of top-quality, guaranteed Water Coolers. Or write for Catalog 59.

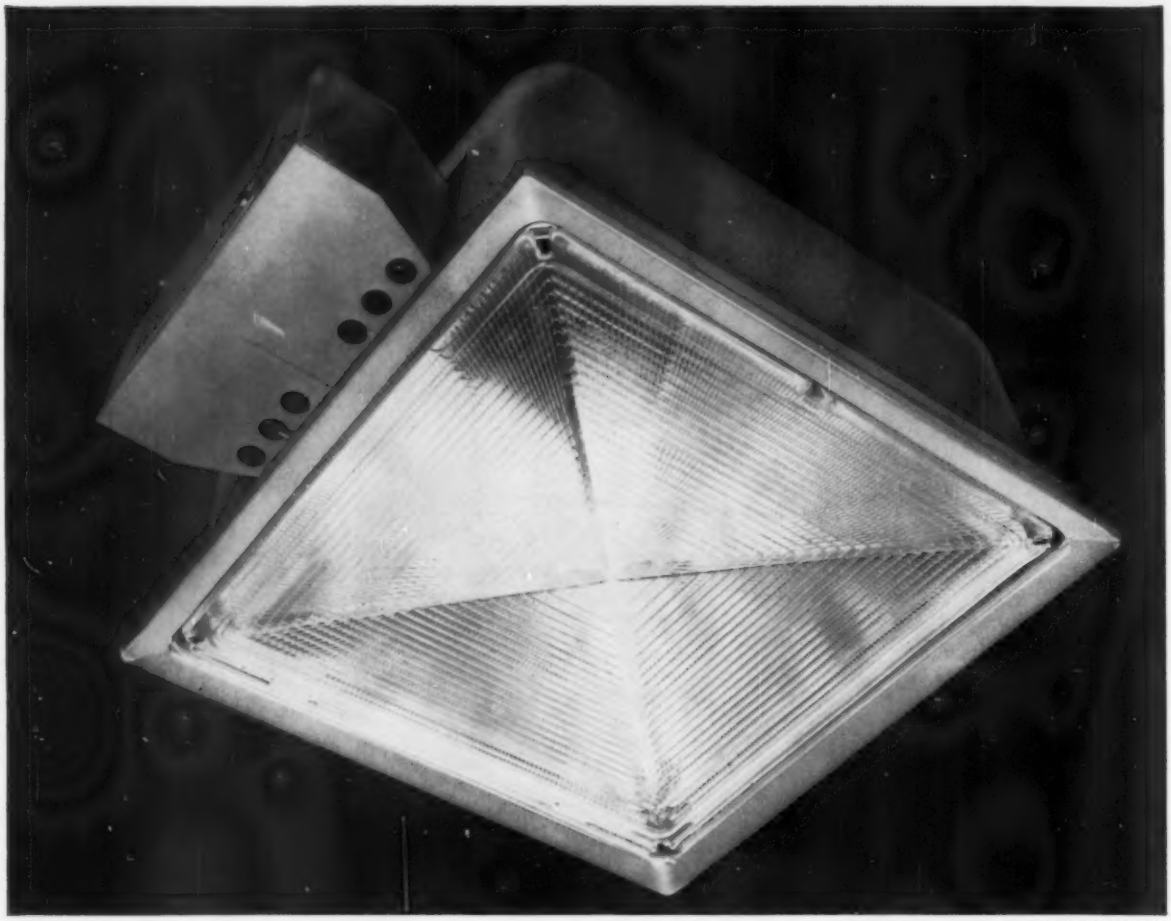
1480

Since 1889 . . . First in water coolers . . . Over 1,000,000 sold

make GraybaR your shopping center for . . .

Everything Electrical GraybaR

The lens box only **DAY-BRITE** could bring you



PATENTS PENDING

UNI-FRAME

Reduced 25% . . . plus great new improvements

Exclusive: Single tapered frame fits ceiling flush. No plaster frame needed. No light leaks.

Exclusive: Reversible knurled nut and adjustable mounting brackets for *easy* installation.

Exclusive: One-piece deep drawn contoured reflector equalizes light distribution over square area.

Exclusive: One box size in two look-alike series for 100 to 300 watt lamps.

A-116

Jewel-like beauty—modular flexibility—your cost reduced 25%. For more about Uni-Frame call your Day-Brite representative listed in the yellow pages.

DECIDEDLY BETTER
DAY-BRITE
LIGHTING FIXTURES

Day-Brite Lighting, Inc., 6248 N. Broadway, St. Louis 15, Mo.
530 Martin Ave., Santa Clara, Calif.

NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT

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GraybaR Everything Electrical GraybaR Electric Company

For qualities beyond your specifications —

CONDULETS*...

made only by Crouse-Hinds

You'll find Condulet electrical equipment in two out of three plants across the country. It's there because electrical engineers have discovered that it provides *more* than standard performance.

And no wonder. Only Condulet rigid conduit fittings have all these features:

✓The wedge-nut cover fastener.

✓Longer hubs for a better wrench grip.

✓Taper tapping to match ASA standard tapered conduit threading for a rigid joint that will not loosen.

✓A triple long-lasting finish that exceeds Federal government and U.L. specifications.

✓A smooth, integral bushing to protect cable insulation.

✓Feraloy, a special alloy that is strong, resists corrosion, and gives full, sharp threads.

For installations where aluminum, plastic or plastic-coated conduit is used, we can supply either copper-free aluminum or plastic-coated Condulet fittings as required.

● *Next time you order, specify Condulet equipment. From the simplest fitting to complex motor controls, the name "Condulet" and the Crouse-Hinds trade-mark are your assurance of receiving the finest.*

* CONDULET is a coined word registered in the U.S. Patent Office. It designates a brand of products made only by the Crouse-Hinds Company.

CROUSE HINDS

MAIN OFFICE AND FACTORY: SYRACUSE, NEW YORK

Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

● CONDULET® ELECTRICAL EQUIPMENT (Explosion-Proof and Conventional) ● FLOODLIGHTING
● TRAFFIC CONTROL SYSTEMS ● AIRPORT LIGHTING and WEATHER MEASURING EQUIPMENT

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Everything Electrical — GraybaR Electric Company

This is a distributor.

"Round the clock service and technical teamwork pay off in 'Missile Town'"

Meet Paul W. Thompson, manager of Graybar Electric Company's Huntsville, Alabama branch office, who uses service and technical teamwork to keep pace with the missile boom in "The Space Capital of the Universe."

"The advent of the space age has changed the face of this whole area. Here at Huntsville, giant Redstone Arsenal and its rocket and missile programs have brought a soaring increase in population—from 12,000 to 70,000 in the space of only four years. We do plenty of business with the scientists at the Arsenal, but the biggest challenge has been in keeping up with the pressing demand for new school buildings that's come with the phenomenal population growth."

"Getting the school business is a full time selling job," says Thompson. "I spend more time with contractors and architects than with anybody. We've been pretty successful in getting them to think Graybar when they think signaling systems, clock systems, or anything electrical. It's not the kind of relationship you build up overnight—we've built it on a reputation for service, quality, confidence and technical help."

make GraybaR your shopping center for...

GRAYBAR Everything Electrical GraybaR ELECTRIC COMPANY

Thompson (center), Bill Seale, manager of Miller Electric Co. (right), and Dick Kingston, Edwards technical representative (seated), work out the best method of tieing-in a new Edwards clock system for a recently built wing of an old school. Here, the problem was an existing bell system much reworked and improvised.

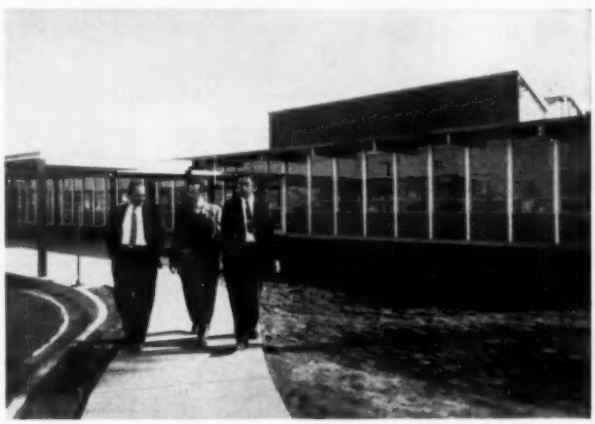
"I rate technical help way up on the list," Thompson says. "We've found this pulls a lot of weight with the contractor. We want them to know they can always count on us for assistance with the knotty problems—just as we know we can count on manufacturers' local technical reps, like Dick Kingston of Edwards, to fill out the technical team that licks these problems."

One of the fastest growing electrical contracting firms in Huntsville is Miller Electric Co. Manager Bill Seale has this to say about Graybar's service: "Graybar can get me anything I want—and provide the kind of assistance we need—without a lot of wasted time running around. We've found that Paul Thompson or any of his staff are available any hour of the day or night to help us with tough installation or parts problems."

"We know we can count on Graybar for service—real service," Seale says. "Many times we've been faced with a crisis and have had to call Paul Thompson the day before we needed figures for our bid—he always comes through. Take the Madison Pike High School job—here's where teamwork between contractor, supplier, and manufacturer really paid off.

We all worked together on specifications, bids, supplies, and installation. Dick Kingston, the Edwards rep, was due for the final check out on the installation—an extensive clock system—on a Thursday. Then the schedule was changed. The inspectors were due *Wednesday*. I called Graybar on Monday. Thompson checked with Kingston in the Edwards Atlanta office and he was on the spot Tuesday morning. The system checked out fine and everyone was happy—most of all, the Madison High Principal. We've got four school jobs going right now that are going to have Edwards systems supplied by Graybar. This is a team that's too good to break up!"

Thompson, Seale, Kingston, and Joe Quarles, Miller Electric's Electrical Superintendent (right), check out Edwards program system with Madison Pike High School Principal, Louis J. Morris (center).



"Quality, confidence, service, and technical help—most of all teamwork by distributor, contractor, and manufacturer—that's the formula that's paying off in Missile Town!"

The Edwards Company believes that distributors have an important but sometimes under-rated job to do in the electrical industry. Often we run across men in distributing like Paul Thompson of Graybar Electric Company who are doing their job very well indeed. We're glad to be able to relay their ideas.

EDWARDS

Specialists in signaling since 1872

CONTROL • COMMUNICATION • PROTECTION

Edwards Company, Inc., Norwalk, Connecticut
(In Canada: Edwards of Canada, Ltd, Owen Sound, Ontario)

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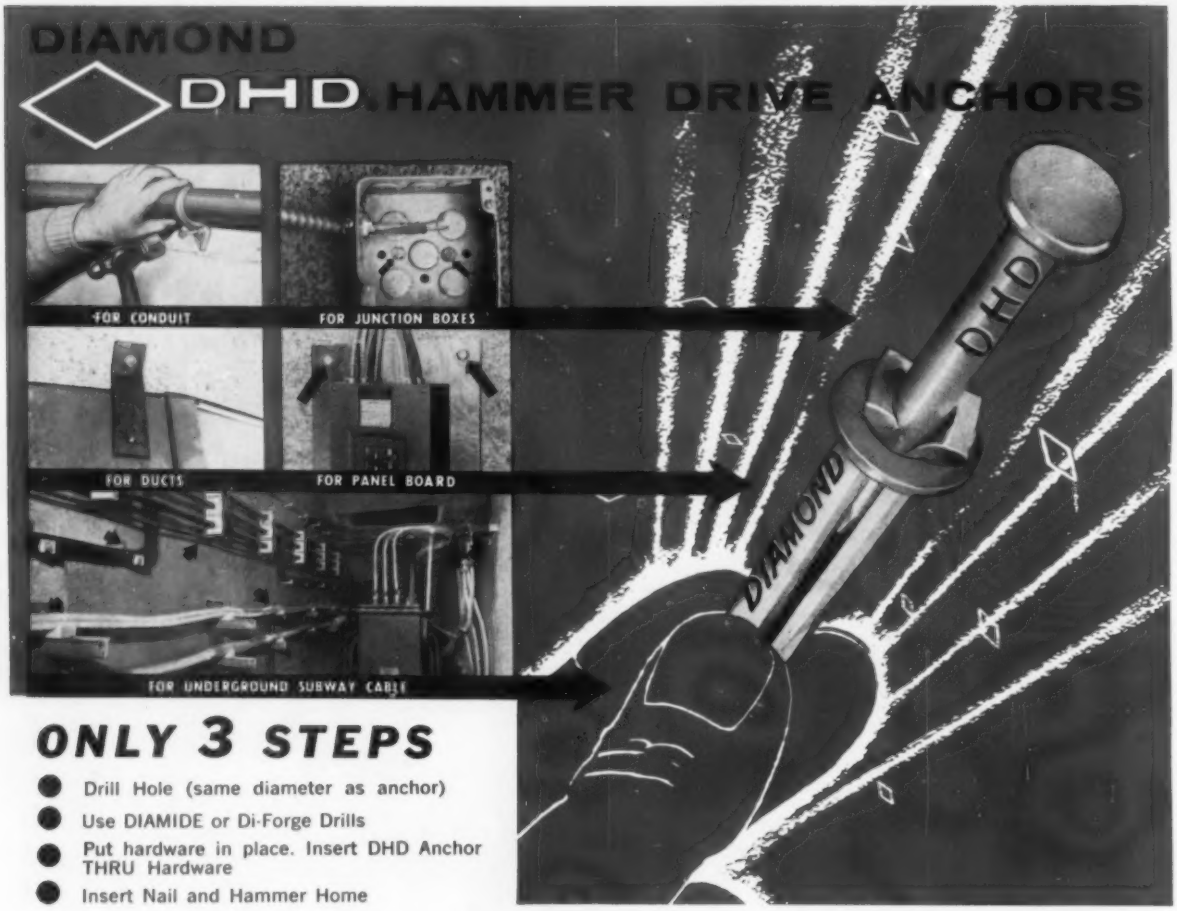
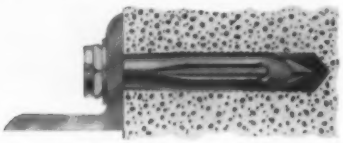
Everything Electrical GraybaR

NOW! ONLY 20 SECONDS* to ANCHOR to BRICK and CONCRETE COMPLETE...HOLE and ALL with



ONLY 3 STEPS

- Drill Hole (same diameter as anchor)
- Use DIAMIDE or Di-Forge Drills
- Put hardware in place. Insert DHD Anchor THRU Hardware
- Insert Nail and Hammer Home



FORGED ALUMINUM NAIL-TYPE ANCHOR ASSEMBLY
(consisting of Anchor and Hot Galvanized Nail)
Size range: 3/16" to 1/2" dia. 3/4" to 3 1/2" length. Exclusive internal rib construction provides variable, radial expansion to compensate for irregularity in hole diameter.

☐ Would you like to put this anchor to a real test? Let us send you a box of 25 without charge. Try them and test them on a job.

☐ Would you like to have a trained anchoring man contact you to help you solve some particular problem. Our representatives are located at these convenient industrial centers and are available for consultation: Atlanta, Boston, Chicago, Dallas, Denver, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco, Seattle, St. Louis, Washington, D. C., also Montreal, and Vancouver, Canada.

☐ Please send me your catalog sheet.

* 3/16" x 3/8" size

DIAMOND EXPANSION BOLT COMPANY, INC.
Garwood, New Jersey

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ECON® DUAL-ELEMENT FUSES

The fusible links open the circuit immediately when a dangerous short develops. The multiple restricted fusing areas cause the heavier sections to drop out in metallic form completely severing the circuit.

Exclusive Econ Alloy thermal element takes harmless overloads up to 500% . . . gives predetermined delay action to avoid unnecessary and costly fuse blows.

When an overload exceeds the predetermined heat and time limits, Econ Alloy reacts instantaneously . . . changing directly from solid to liquid. The usual intermediate plastic stage is completely eliminated. Protecting action is fast and complete with Econ's Super Safety Zone.

with the exclusive Super Safety Zone

- STOP NEEDLESS FUSE BLOWS
- MINIMIZE COSTLY DOWNTIME
- ECON SAVES MONEY ON FUSING
- EXTRA PROTECTION AGAINST BURNOUTS

In Econ's Super Safety Zone you'll find an important difference in action . . . a money saving . . . circuit protecting action that spells lowered costs all down the line.

In this Super Safety Zone, harmless or temporary overloads are carried through an exclusive Econ Alloy Element which delays blowing to a predetermined time limit. When overloads exceed the time limit, Econ Alloy breaks the circuit with fast action. This Super Safety feature costs you nothing extra...Another good reason why it's always extra economy to insist on ECONOMY Fuses.

Available in knife blade or ferrule type from 0 to 600 amperes, 250 and 600 volts. Underwriters' Laboratories listed.

Write for ECON Dual-Element Catalog S-60.

it's always extra economy to call for

ECONOMY FUSES

ECONOMY FUSE AND MFG. CO.
2717 Greenview Avenue, Chicago 14, Illinois

B-291

ASK YOUR ELECTRICAL WHOLESALER FOR ECONOMY FUSES . . . THE COMPLETE FUSE LINE

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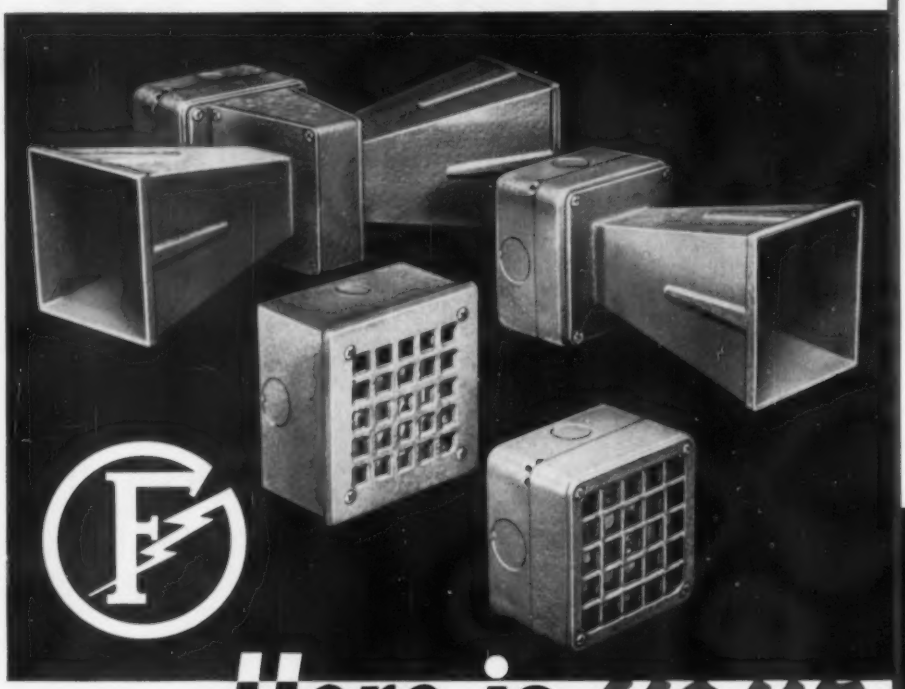
GraybaR Everything Electrical GraybaR ELECTRIC COMPANY



Here is your HORN

You designed it!

FEDERAL custom tailored the ***Vibratone*** to your expressed wish and suggestions for a good looking, compact, durable, trouble-free ***horn signal.***

Now you can have it! Here is your horn that –

- **fits any 4" square outlet box**
- **is self tuning**
- **has full-range volume control**
- **installs almost instantly**
- **is extremely compact**
- **has attractive appearance**

The modular design lets you add accessories, including many standard wiring devices for flush, semi flush, surface, concealed conduit, or weatherproof mounting.

A delight to contractors and electricians! One horn serves all purposes! Save money by substituting the ***FEDERAL #350 Vibratone Horn.*** Your distributor can furnish it. ***Insist*** upon it.

It's competitively priced. Write for full details.

FEDERAL SIGN and SIGNAL Corporation

8726 S. State St., Chicago 19, Ill.

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GraybaR Everything Electrical GraybaR Electric Company

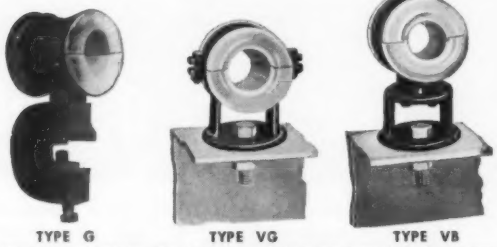
Efficiency

SUSPENSION DEVICES

ARE TIME AND COST SAVERS

By eliminating the need for punching, drilling or burning through beams in order to hang electrical mountings . . . Efficiency Suspension Devices can save you time and expense on practically every construction job.

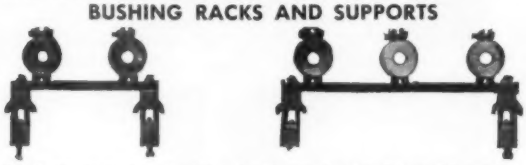
BUSHING SUPPORTS



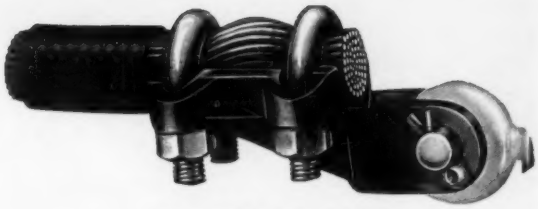
TYPE G TYPE VG TYPE VB

Designed to eliminate the drilling of holes for mounting, these supports are adjustable to any angle. Made of malleable iron with highest quality split porcelain, they are furnished for AC-DC service to handle 5/16" to 2¾" cable. Type G is clamp-mounted while Type VB and VG bolt mounted through its circular base.

BUSHING RACKS AND SUPPORTS



Available in 2, 3, 4, 5 and 6 bushing racks for AC or DC service. Only a single bolt is required to support the bushing and clamp the support to the rack. For 5/16" to 2¾" wire sizes.



CABLE STRAIN CLAMP

Capable of withstanding a direct pull of over 12,500 lbs. before slipping, this clamp can be furnished either with eye or clevis. Three clamp sizes accommodate all cable sizes from 1/0 to 1,500,000 c.m. Constructed of malleable iron, this clamp has a high ridge across the center of the cable channel and a U-bolt at each end.

BUSHING MESSENGER SUPPORT

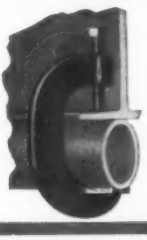
This support is designed to suspend wire or cable from messengers where beam mounting is not possible. This support is a combination of our Type G Bushing Support with strip steel messenger attachment. Furnished complete with malleable iron support, steel messenger attachment and all bolts, as illustrated.

NESTED BUSHING RACKS AND SUPPORTS

Simply and compactly designed to carry conductors equidistant from center to center. Each bushing is a separate unit, allowing independent installation of each cable line. Available in 2, 3, 4, 5 and 6 bushing racks.

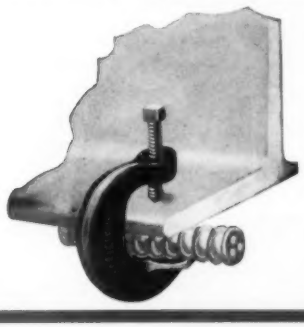
NON-ADJUSTABLE INSULATOR SUPPORT

ADJUSTABLE INSULATOR SUPPORT



CONDUIT HANGERS

Correctly designed for carrying armored cable or ½" to 2¼" pipe along open steel construction. Radiating ridges and the five point gripping surface keeps the pipe suspended dead center, with the set screw above permitting the cable or pipe to be carried at any angle. Made of highest quality malleable iron.



EFFICIENCY ELECTRIC AND MANUFACTURING COMPANY

Write for Catalog EAST PALESTINE, OHIO

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Everything Electrical GraybaR ELECTRIC COMPANY

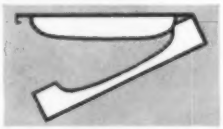
New! Surface Mounted Fixtures by GARCY LIGHTING

- **2 or 4 lamp units, only 3½" deep**
- **Hinged one-piece enclosures**
- **Regular or translucent sides**
- **For 48" rapid start lamps**

Especially suitable for modern low ceilings, the 60th Anniversary Series embodies simplicity in design, glare-free visual comfort and efficient light utilization. This versatile series offers unique advantages to cost-conscious contractors.

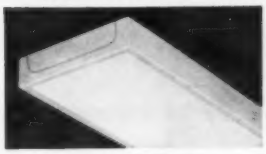
ONLY TWO BASIC PARTS TO INSTALL

1. Compact Chassis
2. One-Piece Enclosure

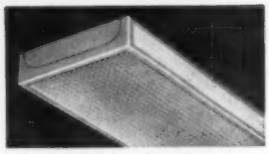


The lightweight chassis is easy to handle. Hinged enclosure is furnished ready for installation . . . no small parts to assemble.

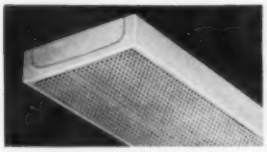
Your Choice of these Distinctive Treatments



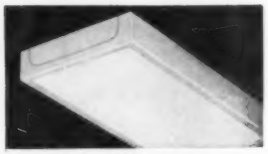
ALBA-LITE GLASS



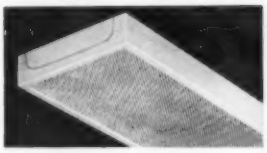
ONE-PIECE PLASTIC LOUVER



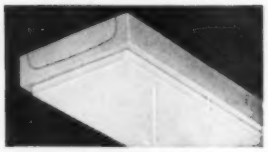
EXTRULITE CLEAR PLASTIC



FLAT PLEXIGLAS PANEL



LOW BRIGHTNESS LENS



DISHED PLASTIC

TRANSLUCENT SIDES

REGULAR SIDES

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In Los Angeles—Garcy Western Corporation, 3912 Broadway Place
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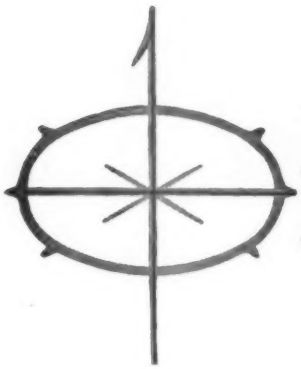
GENERAL CABLE

the largest independent manufacturer of electrical

WIRES and CABLES



QUALITY PRODUCTS to cover every wire and cable requirement.

- **BARE AND WEATHERPROOF** Copper and Aluminum
- **BUILDING WIRES AND CABLES** Rubber and Thermoplastic
- **SERVICE CABLES**
- **POWER AND CONTROL CABLES** Rubber and Thermoplastic Asbestos, Varnished Cloth
- **PORTABLE CORDS AND CABLES**
- **SAFETY MINERAL INSULATED WIRING SYSTEMS**

for quality and service... **specify GENERAL CABLE**

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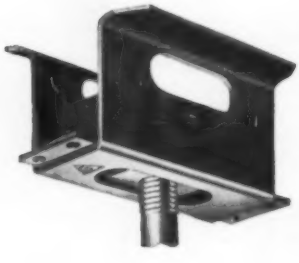
Quick and Easy to Install...
Superior in Quality
GRINNELL Conduit Hangers and Supports

C-Clamp Hanger (Fig. 86)

One Hole Clamp (Fig. 126)

G-Clamp Hanger (Fig. 92)

Wrought Steel Concrete Insert (Fig. 280)



Light Duty U-Bolt (Fig. 120)

Adjustable Wrought Ring (Fig. 269)

The oldest and largest manufacturer of pipe hangers now offers a complete line of rigid hangers and supports for runs of single conduit. Shown here are a few items from this line. Among the advantages you get with Grinnell Hangers and Supports for conduit use are . . .

FAST INSTALLATION
Functional design speeds installation and simplifies erection of conduit.

STANDARD SIZES
Grinnell Hangers are offered in a full range of sizes.

PROVED DESIGNS
Carefully designed, these hangers assure neat installation and safe performance.

DEPENDABLE QUALITY
Exacting standards control quality of hangers from start to finish.

CONVENIENTLY PACKAGED
Most Grinnell Hangers may be had in clearly labeled cartons for more convenience, at no more cost.

PRICED RIGHT
With all these extra benefits, Grinnell Hangers cost no more.

Ask your Graybar Distributor for Grinnell Hangers and Supports. You benefit from more than 100 years of hanger specialization when you insist on the Grinnell name. Grinnell Company, Inc., 277 West Exchange St., Providence 1, R. I.

GRINNELL, AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPLIERS

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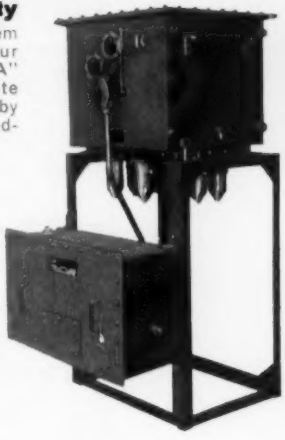
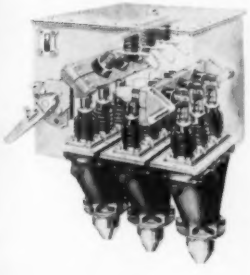
equipment of proved dependability

LOAD-BREAK OIL SWITCHES provide cable system flexibility

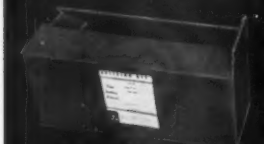
Reduce overtime work on system maintenance. Sectionalize your distribution system with Type "RA" load-break oil switches. Isolate cable faults and restore service by switching loop or duplicate feeders—manually or automatically.

Send for series "D" bulletins.





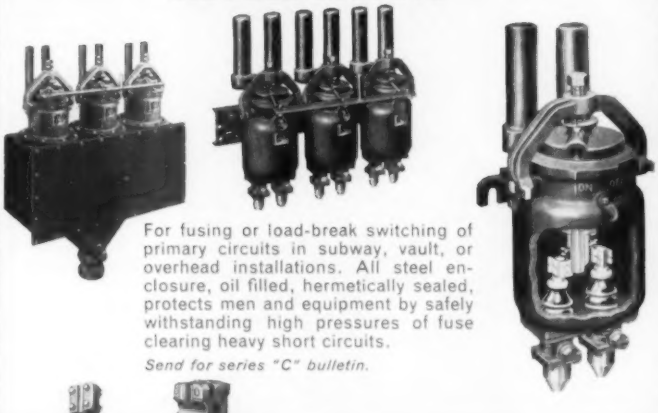
SPLICING KITS, pre-engineered to save time and money



Each item supplied in the correct quantity for a properly designed joint. Time and expense of securing various items from different sources are saved. Accumulation of dead stock is avoided; no waste. All materials kept clean and ready for use. Each splicing kit labeled for easy identification. Cable splicing costs can be determined accurately.

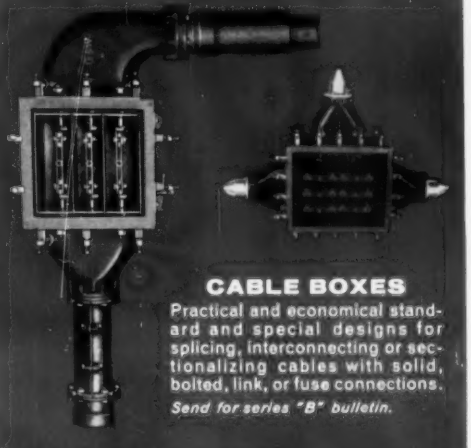
Send for series "J" bulletins.

OIL FUSE CUTOUTS



For fusing or load-break switching of primary circuits in subway, vault, or overhead installations. All steel enclosure, oil filled, hermetically sealed, protects men and equipment by safely withstanding high pressures of fuse clearing heavy short circuits.

Send for series "C" bulletin.

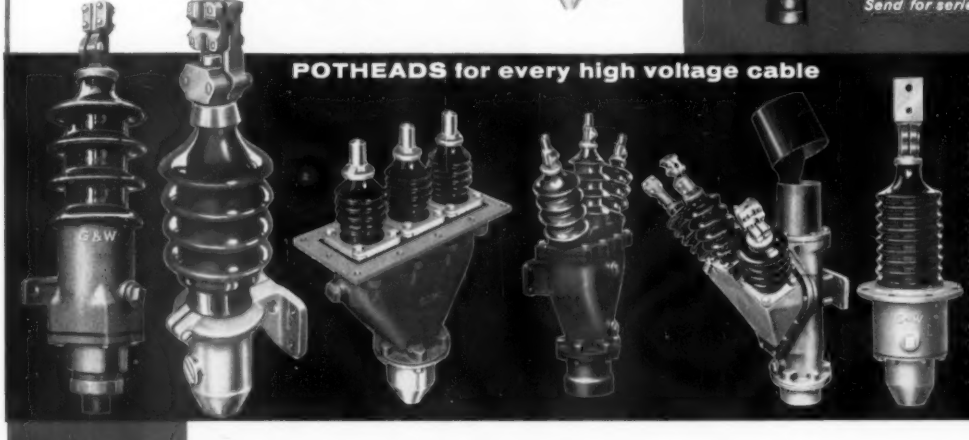


CABLE BOXES

Practical and economical standard and special designs for splicing, interconnecting or sectionalizing cables with solid, bolted, link, or fuse connections.

Send for series "B" bulletin.

POTHEADS for every high voltage cable



Sodertite, capnut, disconnecting. Solder, clamp, or press-style connectors for copper conductors; press-style for aluminum conductors. Wiping sleeve or stuffing box cable entrance seals. Conduit and armor fittings.

For detailed information on the complete G & W line send for series "A" bulletins.

G&W ELECTRIC SPECIALTY CO.

3500 W. 127th Street, Blue Island, Ill. Representatives in principal cities of N. and S. America

Canadian Mfgr.: Powerlite Devices, Ltd., Toronto

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NOW···GLOBE OFFERS···
two new INTERCHANGEABLE trays for support of cables, wiring and tubing

★ Engineered for uniform design and easy installation
★ Steel or aluminum construction
★ Complete accessories for SPEEDIER Installation
★ No sharp edges to damage cables
★ Complete interchangeability

Now, for the first time, two types of cable trays, one a ladder type and the other a basket type, are available to be used INTERCHANGEABLY at any given location, depending on the type and weight of the cables to be suspended. The advantages of each type tray can thus be used to the fullest extent. Globetray, the ladder type, is intended for use where festooning is not a problem, while Cable-Strut, the basket type, is intended for the support of communication wire, instrument tubing and control cables in automation applications.

These two cable trays have been thoroughly field tested in hundreds of large industrial installations, in new plant construction, in power plants, in modernization, and for power distribution in all types of manufacturing processes. A new catalog, just off the press, gives full information and installation techniques. Ask for your FREE copy today.

Distributors are to be found in all principal cities— consult the yellow pages in your phone book under "Gratings" or "Conduits" for the one nearest you.

109

PRODUCTS DIVISION

The **GLOBE** *Company* MANUFACTURERS SINCE 1914

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MORE NEW WAYS TO CUT JOB COSTS

with Greenlee timesaving tools...

NEW, FASTER CONDUIT BENDERS

full 90° bend with one ram stroke

New GREENLEE No. 883 Lightweight Hydraulic Conduit Bender quickly makes accurate bends in these eight sizes of conduit: ½" - 3" . . . up to 90° with one ram stroke. Hand-pump or power-pump operated.

One set of rotating supports for all eight conduit sizes . . . supports also serve as rollers for wheeling bender from job to job.

Positive-locking support pins cannot come loose. Conduit easily inserted and removed from front of bender.

Bending gauge included for accurate results with minimum calculations. A compact, lightweight, portable tool for faster, lower cost conduit work. GREENLEE Lightweight Bender line includes three models for ½" - 2", ½" - 3", and ½" - 4" conduit.

NEW, FASTER KNOCKOUT TOOLS...

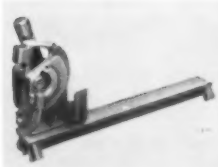
no pre-drilling or step-up punching!

New GREENLEE One-Shot Knockout Punch Drivers save many dollars on conduit installations. Lightweight, easy to carry, powerful. Fast one-man setup and operation.

"C" frame fits around junction box and 8" deep throat lets you position punch exactly where needed.

High-strength aluminum frame provides ample rigidity for slicing through 10-gauge steel with a few strokes of the hydraulic pump.

Two sizes: No. 1731 fits GREENLEE Punches ½", ¾", and 1" with special dies. Weighs only 15 lb. No. 1732 fits all GREENLEE Punches and Dies ½" - 4". Weighs only 35 lb. Both models operated with hand or power pump.



NEW RATCHET HAND BENDER

For quick, easy bending of ½", ¾", 1" conduit up to 90°. Ratchet action permits short, powerful strokes. No. 1800.

NEW RATCHET KNOCKOUT PUNCH DRIVER

Anti-friction, fast-lead thread gives 6 to 8 times faster action than ordinary wrench method. For all GREENLEE Punches ½" - 3". No. 1804.

HYDRAULIC DRIVER AND KNOCKOUT PUNCHES

The right combination for making conduit openings in seconds. Driver available separately or in handy sets with GREENLEE Knockout Punches.

PORTABLE HYDRAULIC POWER PUMPS

For GREENLEE Hydraulic Conduit Benders and Knockout Punch Drivers. Fast approach, automatic change to high-pressure drive.

PRECISION-MADE BORING TOOLS

A complete line of power and brace bits for electrical work. New hex shank power bits give positive drive without slippage.

SEE YOUR ELECTRICAL DISTRIBUTOR for complete information on these and many other timesaving GREENLEE tools for the electrician.

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GREENLEE

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FOR HUNDREDS OF

STANDARD

SIZES

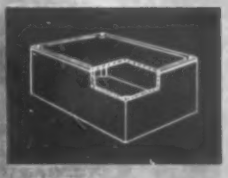
...PLUS COUNTLESS

CUSTOM

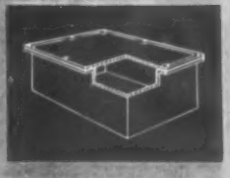
VARIATIONS

...CAST BOXES* BY HOPE

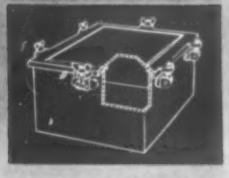
STANDARD TYPES & SIZES



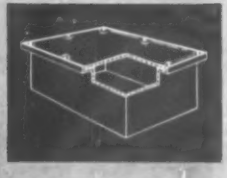
UNFLANGED BOXES
H1200 Type
164 sizes
from 4 x 2 x 2 to 48 x 36 x 17



FLAT FLANGED BOXES
H8000 Type
87 sizes
from 4 x 4 x 3 to 36 x 36 x 12



HINGED COVER BOXES
H3200 Type
128 sizes
from 5 x 5 x 3 to 36 x 36 x 12



FLANGED RECESSED COVER BOXES
H7000 Type
51 sizes
from 4 x 4 x 3 to 30 x 24 x 12

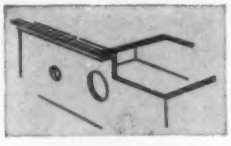
CHECKERED COVER SIDEWALK BOXES
H5800 Type
53 sizes
from 6 x 6 x 4 to 36 x 24 x 14

STANDARD BOXES are of strong, dense cast iron—hot dip galvanized for long service and attractive appearance. Weatherproof construction—rubber-gasketed closure prevents entry of rain, snow, sleet or dust under normal conditions.

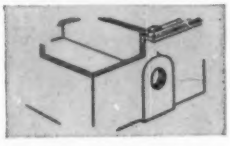
CUSTOM VARIATIONS

You can specify any of these modifications in standard BOXES by HOPE –have them factory-made at moderate cost–and get prompt delivery.

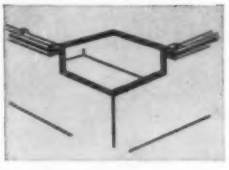
DRILLING—
or drilling and tapping—
of conduit entrances



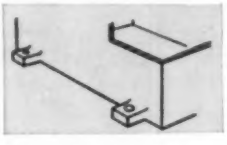
BOSSES—
to provide extra thickness
for five-thread conduit entrances.
Drilled and tapped to specification
if desired



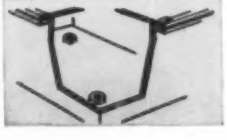
SPECIAL GASKETS —
Neoprene for fungus resistance in hot, humid climates • pure gum for extreme softness and resistance to special acids • Vellumoid for resistance to oils and fats • graphite-free compressed asbestos for installation near boilers or steam pipes



MOUNTING LUGS—
drilled for bolts



INTERIOR MOUNTING BUTTONS—
—tapped blind
to specified centers



AND . . . you can order these custom modifications, as well as standard BOXES by HOPE, conveniently and quickly, through your local electrical distributor.

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IT PAYS TO HAVE HUBBELL GOOD CONNECTIONS

Illustration, above, shows size relationship of a Hubbell 4-wire, 50 amp. "Twist-Lock" cap and a midget 2-wire, 10 amp. "Twist-Lock" cap . . . a good indication of the wide range of sizes and ratings available.

Twist-Lock®

. . . for every purpose

"Twist-Lock", *first and still the finest locking connector made,* is designed for portable electrical equipment requiring constant contact pressure and safe, secure locking protection and convenience. It is ruggedly constructed to withstand abuse and provide long life service. "Twist-Lock" offers many wiring features which simplify installation and eliminate costly service call-backs.

8 DIFFERENT LINES

"Twist-Lock" represents the safest and most complete quality line of locking connectors ever developed. Caps, connector bodies, motor bases and receptacles are available in the eight different types and sizes shown at right, and in ratings to conform to your electrical specifications.

Every cap and connector body from 10 amp. to 50 amp. is now available with "Seal-Tite" rubber covers for weatherproofing purposes, protection from dust and dirt or from hard knocks and rough usage.

HARVEY HUBBELL, INCORPORATED

BRIDGEPORT 2, CONNECTICUT • IN CANADA: SCARBOROUGH, ONTARIO

REGULAR Twist-Lock

Rugged construction. Regular wiring. Wide range of types and ratings.

SUPER Twist-Lock

Screwless terminals and dead front for faster, safer wiring.

MIDGET Twist-Lock

The same high quality in midget size. Many O.E.M. uses. Wide selection of types and ratings.

GROUNDING Twist-Lock

For 125 v. grounding only. Non-interchangeable with regular "Twist-Lock".

"INSULPRENE" Twist-Lock

Tough neoprene compound resists steam, hot water, grease, acids, etc.

30 AMP. SUPER Twist-Lock

Non-interchangeable with 20 amp. units. Prevents interchange between 20 and 30 amp. service. Screwless terminals and dead front.

50 AMPERE Twist-Lock

In 600 v. A.C. and 250 v. D.C. Solderless connections. Metal cord grips.

277 VOLT Twist-Lock

Non-interchangeable with other "Twist-Lock" or any other device made. Used for fluorescent lighting.

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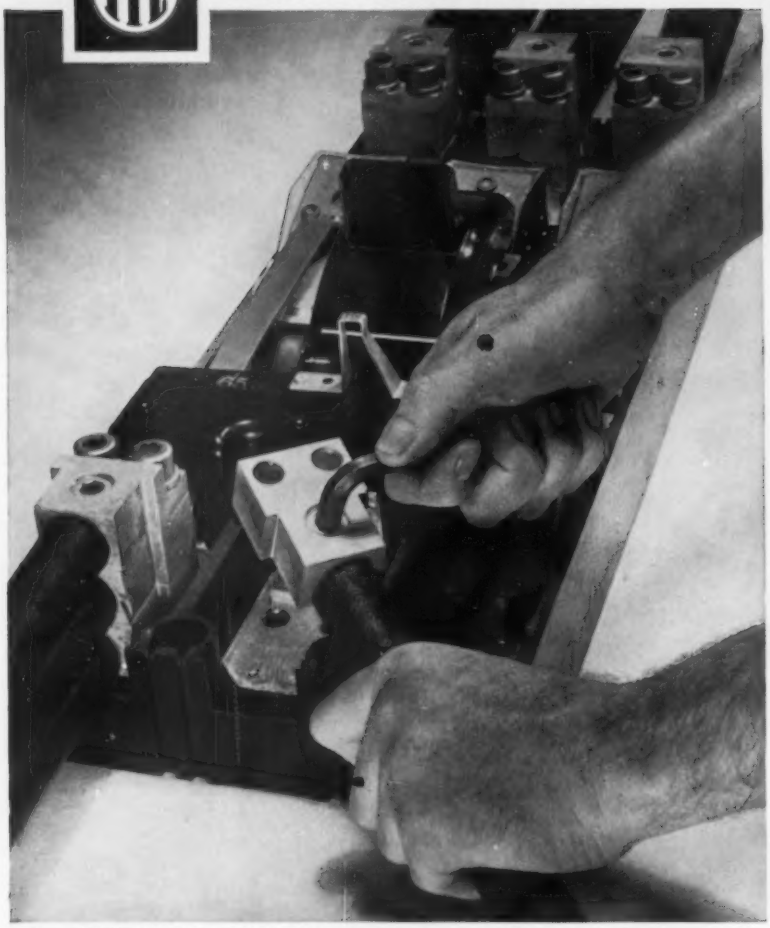
MOLDED CASE CIRCUIT BREAKERS



These individual cable lugs, each with an Allen head locking bolt, make connection of cables far easier and provide a much sturdier, neater assembly. An exclusive on all I-T-E 800 ampere breakers. UL approved for service entrance equipment.

SEVERAL EXCLUSIVE I-T-E FEATURES COMBINE TO SAVE YOU MONEY WHEN INSTALLING CIRCUIT BREAKER EQUIPMENT

In designing molded case circuit breakers for higher capacities, for example, I-T-E design engineers recognized that the difficulties inherent in making large multiple cable connections had to be considered. Pictured above is their solution—"stacked" lugs for time-saving installation. No need to fight clumsy, unyielding cables.

I-T-E enclosures, too, have exclusive, built-in features which greatly facilitate installation of circuit breaker equipment—saving additional installation time. And since time is certainly money these days, consider the time-saving features pictured here and you'll see how I-T-E can save you money even before your I-T-E breakers are in service! I-T-E Circuit Breaker Company, 1900 Hamilton St., Philadelphia 30, Pa. *In Canada:* Eastern Power Devices Ltd., Port Credit, Ont.

I-T-E enclosures are side-hinged—no need to remove, or prop up, the cover. It is nevertheless easily removed, the hinge being of the pin-and-socket type—lifts off and on readily.

Field checks indicated that the addition of a supporting bracket would be a big help in installing larger breakers, and this feature is now added on all large-size enclosures.

To facilitate drilling holes of the desired size and position, end-plates of larger enclosures can be unscrewed and removed. Drill to your exact conduit needs.

I-T-E CIRCUIT BREAKER COMPANY

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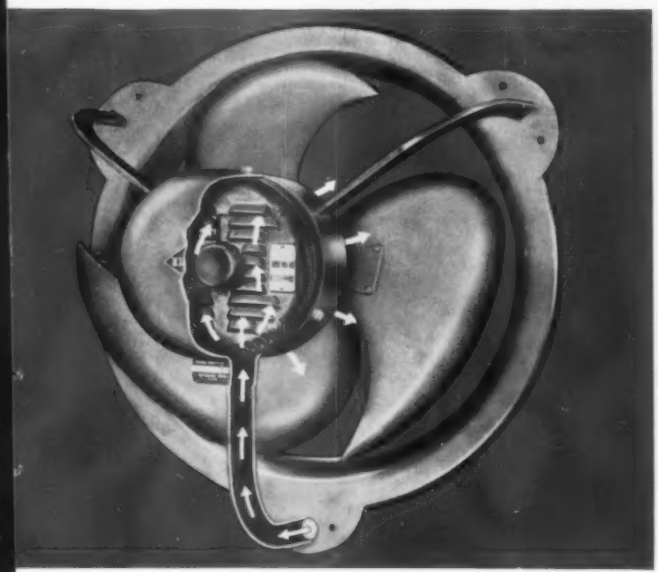
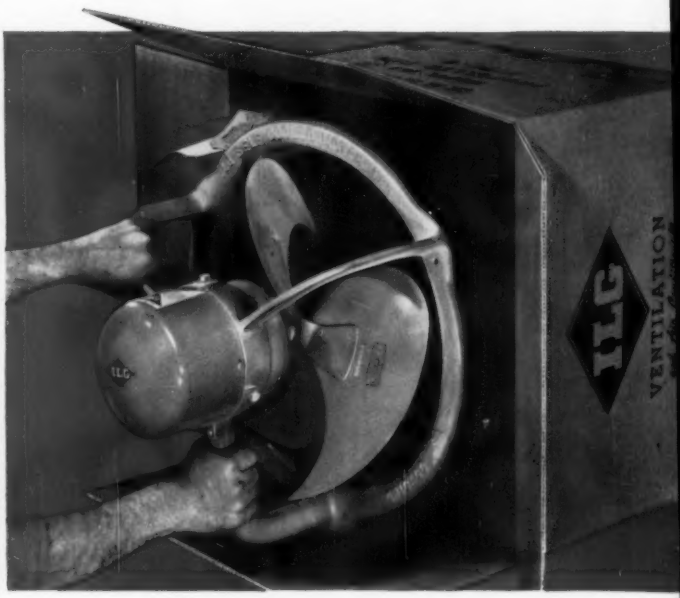
At His Finger Tips (and Yours). Ilg's "One-Name-Plate" guarantee covers both the Ilg-built *self-cooled*, direct-connected motor and the dynamically balanced, patented "Q" Type fan wheel.

Not a Ripple at 1140 revolutions. Put a glass of water on an Ilg direct-connected, *self-cooled* propeller fan and you'll see how vibration-free a fan can be at full operating speed. Notice: not a ripple!

only at ILG can you count on all four



Follow the Arrows and you'll see why Ilg-built *self-cooled* motors stay cleaner, run quieter, last longer. Vent pipe brings in clean outside air; pressure cools direct-connected motor . . . exhausts air at front of fan. Motors never run hot.



Quiet in the Carton, Too. Ilg *self-cooled*, direct-connected propeller fans not only *run* without vibration . . . they arrive on the job site in perfect shape. Ilg "vibration-tests" fans in shipping boxes and cartons. No chance for cargo shift.

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2879 N. Pulaski Road, Chicago 41, Ill.
Offices in 57 Principal Cities
Member of Air Moving and Conditioning Association Inc. (AMCA)

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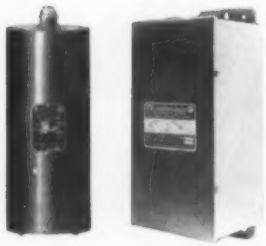
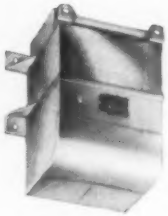
...for rapid installation, rugged reliability and prolonged life

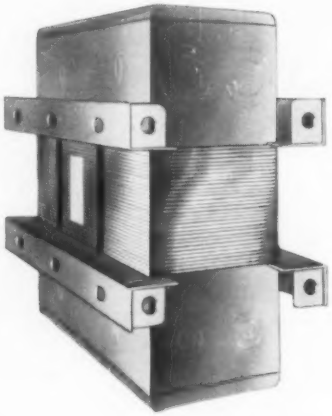
Jefferson transformers and ballasts



MERCURY LAMP BALLASTS
The *world's most complete* line of ballasts for street lighting, outdoor and indoor commercial and industrial mercury lamp installations . . . outdoor models include Jefferson's exclusive moisture-proof Aqualift Sealant.

FLUORESCENT LAMP BALLASTS
Many design and manufacturing safeguards insure the low noise level of every model in this complete line.





DRY TYPE TRANSFORMERS
Available from 50 VA single phase transformers up through 300 KVA 3-phase units. There's a Jefferson dry type transformer to fit your needs.

Jefferson ELECTRIC COMPANY
Jefferson Electric Company, Bellwood, Illinois

make GraybaR your shopping center for...

Everything Electrical GraybaR

IDEAL WIRING TOOLS...

a good way to cut costs thru faster better work by the Man-on-the Job!

Ideal Wiring Tools help your men do a better job faster. Contractors and electricians coast to coast consider Ideal tools "standard" equipment for ease of use and efficiency on the job.

Get exactly the tools you need—when you need them. It's fast and economical, just specify Ideal—one dependable source for everything in electricians tools. Shown here are just a few items from the complete Ideal line.

IDEAL VOLTAGE TESTER

"Easy Tester" 2-ways safe

This is a voltage tester that protects you two ways! It has both a neon test lamp and a calibrated solenoid indicator . . . each independent of the other. No chance of failure to detect voltage. Handy center mount for the prod keeps the indicator always in the line of vision. Case is of double strength seamless plastic, with no external metal. Molded prod handles have "No-Slip" safety rings, are mounted on 30" leads. Prods when not in use are completely shielded in case. Tests 110 to 550 volts AC—110 to 600 volts DC.

IDEAL FISH TAPE REEL and PULLER

The big grip that takes most of the work out of fishing. Actually lets you do the job in 50% of the time as compared to hand fishing . . . like an extra arm or bigger muscles. And they may save your life—because the tape is always in reel or conduit. It can't ever spring loose into "hot" wires or moving machinery. Also, no cuts, skinned fingers or lost time! 50 to 200-foot lengths — all tapes of finest oil tempered flat spring steel.

NEW Low Cost WIRE STRIPPER

Strips wires from 10-18 ga. cleanly, quickly, and easily. Also used for cutting and "looping" wires. A handy addition to every electrician's tool kit. Sturdy, compact-constructed of hardened steel for rugged duty and long service life. Contoured plastic grips for easy handling and safety. Overall size 6". Flat design for easy tool kit and pocket fit.

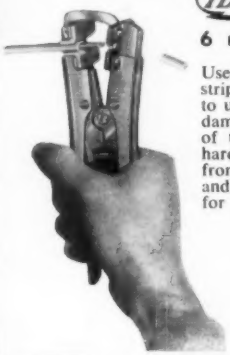
IDEAL FISH TAPE WINDER

"Fishing" made easy

Just roll it around our IDEAL Fish Tape Reel. Spreads the Reel housing, so that Tape reels in or out much more easily. Just rotate the handle. Double rollers hold the Winder in place. Three sizes fit all IDEAL Reels.

IDEAL "E-Z" STRIPPER

6 models including *UF cable stripper



Used more, liked more and sold more than any stripper we know of. Rugged, all-steel and as easy to use as pliers. They are so designed that they can't damage wire or crush stranded wire ends, because of their automatic lock. Replaceable blades are of hardened steel. Six models handle all wire gauges from No. 8 to No. 26, also 300 ohm TV down lead and most non-metallic sheathed cable. The stripper for heavy-duty work.

**"E-Z" UF cable stripper strips the outer sheath and web, then the inner conductors (2 or 3 wire, 12 or 14 ga.) from non-metallic sheathed cable—without cutting, nicking, or other damage to wire ends.*

IDEAL WIRE LUBE

Less Work, Strain, and Danger of Insulation Breaks!

IDEAL Wire-Lube actually lubricates wires and cables just like the oil you use in your car to lubricate bearings. It lets you slide wires into or out of conduit easier, dries to a fine powder, is as gentle on your hands as a fine soap. It is non-combustible, non-corrosive. For use on rubber, lead or plastic covered wire or cable. Available in 1 quart cans to 5-gal. pails.

IDEAL COMBINATION FUSE PULLER AND TEST-LITE

NEW

A new tool for maximum safety in pulling cartridge-type fuses and in checking electrical connections. Sure-grip dielectric plastic handles make fuse pulling faster. Positive testing is assured by built-in resistors which limit current flow through the tester. Test capacity from 100V. to 600V. AC or DC. Designed for use on fuses up to 100 amp., 250 volts and 60 amps., 600 volts.

IDEAL INDUSTRIES, Inc.

1041-B Park Avenue, Sycamore, Illinois

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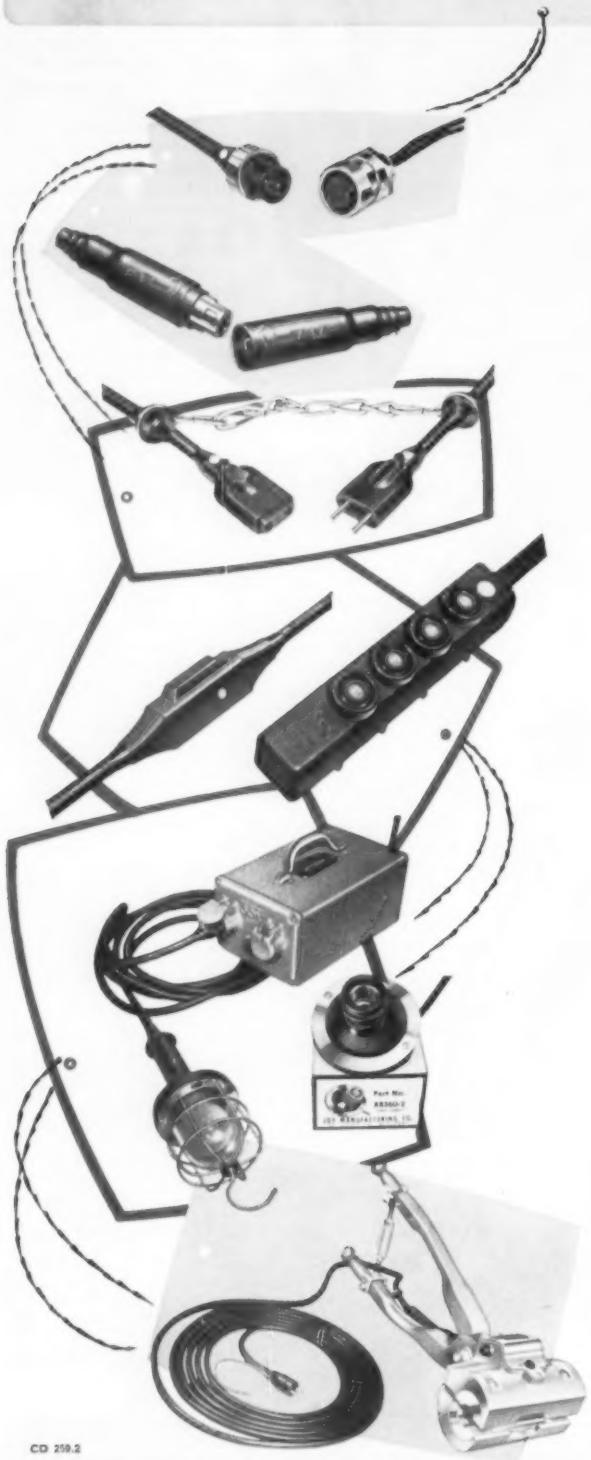
JOY ELECTRIC PRODUCTS FOR YOUR BEST CONNECTIONS



CD 259.2

Put quality on the line with Neoprene encased electrical connectors and devices by JOY. Consult your nearby Graybar Man now about JOY safe, durable, and 100% watertight products. Molded-to-cable designs especially suited to provide ultimate in tough moisture-sealed construction.

Send for the Bulletins you need Today!

PRODUCT CLASSIFICATION	GENERAL DESCRIPTION	CAT. NOS.
ELECTRICAL CONNECTORS	JOY "Change-out" Connectors. Mount directly on panels, ducts, outlet boxes, control equipment, etc. Available with 2 thru 4 contacts, up to 20 Amps., 600 V service.	B68
	JOY Type "V" Welding Plugs. Attachable design. Supplied in one size that fits all cable from #4 thru 4/0 A. W. G. Locking engagement with water seal.	F44
	JOY Oval "Push-pull" Connectors for electric lifting magnets. Neoprene molded-to-cable construction. Shatter-proof, moisture-tight and distortion resistant.	B71
ELECTRICAL SWITCHES	JOY "Precision" switches. Choice of 2, 3 or 4 wire units in feed thru or pendant style. Hermetically enclosed in Neoprene.	B68
	JOY Pendant style push-button "Safe" switches for controlling electric motor driven hoists, etc. Housed in resilient Neoprene.	F49
LIGHTING EQUIPMENT	JOY "Low Voltage" lighting sets. Choice of 8, 12, or 32 V. multiple outlet units @ 300 and 400 V. A. ratings. Submersible hand-lamp assemblies on 25 or 50 ft. extension cords.	F45
	JOY "Shatter-proof" bulb sockets. Mount directly on standard 4" outlet boxes. Dampen vibration, prolong filament life.	B71
VULCANIZING PRESSES	JOY "Portable" and "All-Purpose" (bench type) direct heat cable vulcanizers for replacing insulation and repairing jacketing on rubber, rubber synthetic and Thermo plastic jacketed cable. Choice of voltages.	B70

JOY

JOY MANUFACTURING COMPANY

ELECTRICAL PRODUCTS DIV., 1231 MACKLIND AVE., ST. LOUIS 10, MO.

EXECUTIVE OFFICES — HENRY W. OLIVER BLDG., PITTSBURGH 22, PA.

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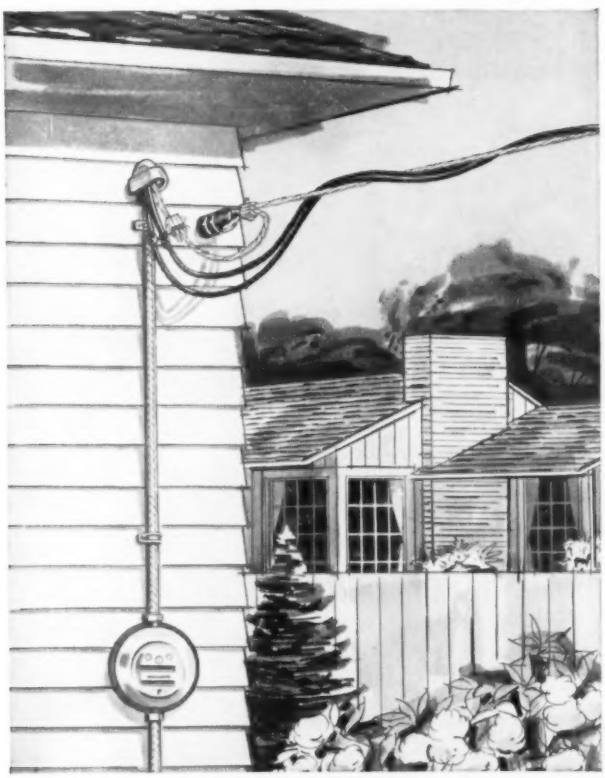
NOW! LOOK HOW MUCH YOU SAVE BY SWITCHING FROM COPPER TO ALUMINUM SE-U!

COST COMPARISON—ALUMINUM VS. COPPER

Service Entrance Cable
Concentric Uninsulated Full Neutral, Braid Jacketed
Underwriters' Type SE, Style U, 75° C. Operation

SERVICE		ALUMINUM		COPPER		SAVINGS WITH ALUMINUM	
Amperes	Feet	Conductor Size AWG	Cable Cost $	Conductor Size AWG	Cable Cost $	$	%
100	20	2	5.50	3	9.48	3.98	42
.....	40	2	11.00	3	18.96	7.96	42
.....	60	2	16.50	3	28.44	11.94	42
150	20	2/0	9.46	1/0	22.24	12.78	58
200	20	4/0	12.80	3/0	31.26	18.46	60

NOTE: Based on prices in effect as of January 1, 1959.



Check the table . . . at today's prices, braided aluminum SE-U saves you money over copper right down the line!

Note that the cost of #2 aluminum SE-U is *42% lower* than #3 copper SE-U. With the trend toward larger sizes, savings with aluminum become even greater—up to 60% for 200 ampere service! Neoprene jacketed aluminum cables offer similar savings.

FREE BROCHURE GIVES YOU THE FACTS

Our new, free brochure, *"KW Service Entrance Cable,"* points out the distinctive characteristics of both braided and neoprene jacketed aluminum cable, and fully explains why this cable offers definite advantages over copper.

It also describes and illustrates applications of SE-U Cable, as well as Single Conductor in Conduit, and contains a list of manufacturers of accessories for both applications.

Get your free copy of this informative 8-page brochure now. Mail the coupon!

KAISER ALUMINUM

IF IT CARRIES CURRENT, K/W CARRIES IT!

Kaiser Aluminum & Chemical Corp.
Dept. 953-G
919 N. Michigan Ave., Chicago 11, Ill.

Please send your free brochure, *"KW Service Entrance Cable."*

Name_____

Address_____

City_____ State_____

FOR TOP QUALITY K/W SERVICE ENTRANCE CABLE, CONTACT YOUR NEAREST GRAYBAR OFFICE TODAY!

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For the fastest, easiest, most accurate way to bend rigid or thinwall conduit

NO. 1 AND NO. 1T

YOU CAN BEND ½"–¾" and 1" CONDUIT EASILY WITHOUT CHANGING PARTS

These are complete machines of all steel construction. No loose parts that can be misplaced or lost. The "Chicago" bender gives you perfect, smooth, uniform bends every time. It's simple to make repeat bends because our exclusive calibrated degree scale (shown in circle) eliminates guesswork as to accuracy. Even 180° bends are simple and easy to make. When using a "Chicago" bender you always turn out professional work quickly without special skill. The accurate bending sector does the work and supports the full length of bend. Its low maintenance and light weight (66 lbs.) make it a real on-the-job tool. When ordering without stand for truck or post mounting, clamp bars can be furnished.

BENDING CIRCLES: INSIDE RADIUS:

	No. 1	No. 1T
½" CONDUIT OR PIPE	2"	EMT 3"
¾" CONDUIT OR PIPE	4¼"	EMT 4½"
1" CONDUIT OR PIPE	5¾"	EMT 6½"

NO. 2 AND NO. 2T

FOR HEAVY DUTY CONDUIT... BENDS 1¼" and 1½" PIPE WITH EASE

This is also a complete machine of all steel construction incorporating a simple but extremely powerful toggle-ratchet mechanism which has been field proven for many years and requires no maintenance other than an occasional drop of oil. It's designed for real outdoor work. By using extension plugs, the No. 2 like the No. 1 will produce conduit ells at a considerable saving. Smooth offset are easy and fast to make. These machines will operate in any position where conditions make it easier to move the machine . . . yet the rugged stand gives solid support at a comfortable working height. The same type of degree scale (shown in circle) reads actual bend directly and makes repeats easy. Stands have built-in square and scale for checking bends.

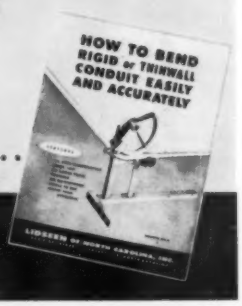
BENDING CIRCLES: INSIDE RADIUS:

	No. 2	No. 2T
1¼" CONDUIT OR PIPE	7¼"	EMT 9½"
1½" CONDUIT OR PIPE	8¾"	EMT 10½"

EXCLUSIVE . . . CALIBRATED DEGREE SCALE GIVES YOU ACCURATE REPEAT BENDS

1. Stand
2. Back plate
3. Carriage bolt
4. Pawl release
5. Handle
7. Sector
9. Jaw
10. Degree scale
12. Square

For full details get your copy of Bulletin No. 556.....



LIDSEEN OF NORTH CAROLINA, INC.

1000 FIRST STREET • HAYESVILLE, NORTH CAROLINA

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GraybaR Everything Electrical GraybaR ELECTRIC COMPANY

Many tests are made to compare various conduits under different exposure conditions. One of the most severe is the sulfuric acid test. Immerged into a 7½% solution of sulfuric acid, the zinc protection on ordinary brands of conduit fails in less than 6 hours, while the MVC-1 coating on SHERARDUCT stands up for 72 hours and longer. Other accelerated tests—salt spray, caustic soda, etc.—do not affect the MVC-1 polyvinyl coating.

HOT ZINC COATED

SHERARDUCT with MVC-1

provides permanent protection of electrical wiring

Even under the most severe service conditions, hot zinc coated SHERARDUCT with MVC-1 gives lifetime protection of wiring. MVC-1—the baked-on polyvinyl chloride resin coating—is an exclusive National Electric development. It resists all types of corrosion. On top of the hot zinc coating of SHERARDUCT, MVC-1 adds years to the service life of your conduit system . . . even in extreme service exposure conditions.

In addition to its exceptionally high corrosion resistant properties, MVC-1 is exceptionally resistant to abrasion, and it is not adversely affected by high or low temperatures. Once installed, hot zinc coated SHERARDUCT with MVC-1 is there to stay.

SHERARDUCT also gives you time-saving and money-saving benefits on the job. The slow heating-cooling "normalizing" process gives SHERARDUCT easy-to-bend properties, easy to cut and re-thread in the field—no cracking, no flaking of the finish. Besides, the smooth inside surface of the polyvinyl coating makes fishing easier and faster . . . provides protection against corrosion for the interior of SHERARDUCT.

Added together, these benefits mean hot zinc coated SHERARDUCT with MVC-1 provides top money value . . . in ease of installation . . . in years of protection. Why take less, when with SHERARDUCT you get the best. VMA-6303

National Electric Products Corp.

In Canada: NEPCO of Canada, Ltd.

PITTSBURGH 22, PENNSYLVANIA

SALES OFFICES LISTED UNDER

Bennett Associates, Inc.

Sales Offices and Warehouses in Principal Cities

The NEPCO quality family provides dependable, permanent, maintenance-free electrical systems

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"GraybaR" Everything Electrical GraybaR Electric Company

EFFICIENCY IS *HIGH* WHEN THE TOOL IS A NYE

"The Tools You Swear By... Never At!"

COMBINATION VISE STANDS

Base designed so yoke vise parts (⅛" to 2½") can be replaced by chain vise parts (½" to 4"), or vice versa.

● SEE YOUR JOBBER

PATENTED FEATURES

- JAM PROOF
- AUTOMATIC "kick-out" hand or power
- MANUAL "kick-out" for short threads

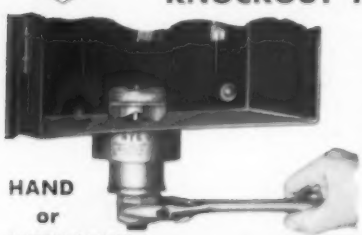
Easiest and fastest pipe threader on the market today. Get a demonstration and you will see why NYE is the best.

NEW HEAVY DUTY SELF LOCKING VISES

Long Jaw Vises . . . a NYE origination. All yoke type vises have a pipe rest and benders on base. Sizes ⅛" to 4½".

● SEE YOUR JOBBER

"FOUR POINT" BALL BEARING KNOCKOUT PUNCHES



Cuts clean burrless holes, fast. Coarse thread on screw drive (12) against (24) lessens cutting operation by 50%.

● SEE YOUR JOBBER

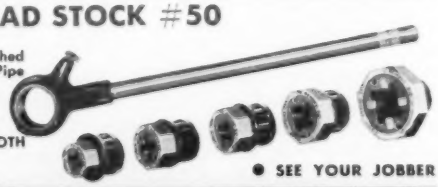
TRIPLEX SOLID DIE STOCK

Excellent for hand or power threading. Supplied in two combinations: ⅜" to ¾" and ½" to 1".

● SEE YOUR JOBBER

NYE TRIAD STOCK #50

Can be furnished for Conduit or Pipe Threads ⅛" to ¾" and ⅛" to 1¼". Exclusive with NYE, the SKIP TOOTH die.



● SEE YOUR JOBBER

NYE TOOL COMPANY 4122 Fullerton Avenue, Chicago 39, Illinois

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NEW

JOINS 26% FASTER

Because there are no separate couplings to assemble on the job, Orangeburg's new CA Conduit lays faster—costs less to install. In addition, there are no coupling cartons to handle, transport or store.

Orangeburg's new CA Conduit comes, at *no extra cost*, with a factory-attached coupling at one end and a standard 2° male taper at the other end. To join—CA's long, lightweight lengths are placed end to end—hammered home in a simple, one-step operation. Actual installations *prove* Orangeburg's new CA Conduit joins up to 26% faster!

What's more, because the attached coupling is *flush* with the outside diameter of the conduit, new CA Conduit is easy to handle and store in neat, even stacks. And with the new flush coupling there's no need to "stagger" conduit joints in the trench. That means less cutting and tooling time.

New CA Conduit—like the millions of feet of Orangeburg Fibre Conduit in use since 1893—has self-sealing joints and impermeable walls that make it absolutely watertight. Its smooth 100% fibre raceway adds years to cable life.

Specify new CA Conduit on your next job. This addition to Orangeburg's line is available in 2", 3", 4", 4½" and 5" sizes. Orangeburg's Standard and Nocrete Conduit with separate sleeve couplings are available as always. Orangeburg Manufacturing Co., Orangeburg, N. Y. and Newark, Calif.

ORANGEBURG MANUFACTURING CO.
A Division of The Flintkote Company, Manufacturers of America's Broadest Line of Building Products

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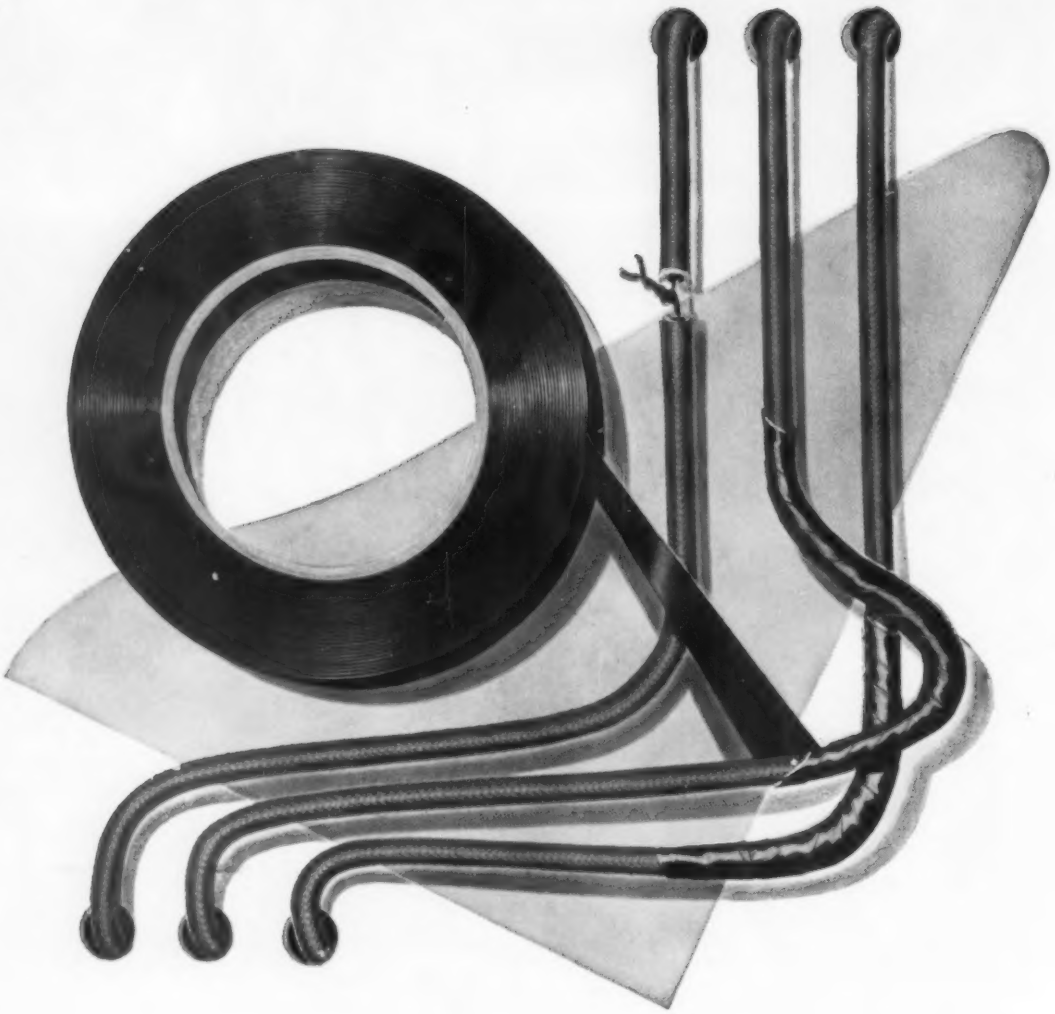


whatever the job . . .

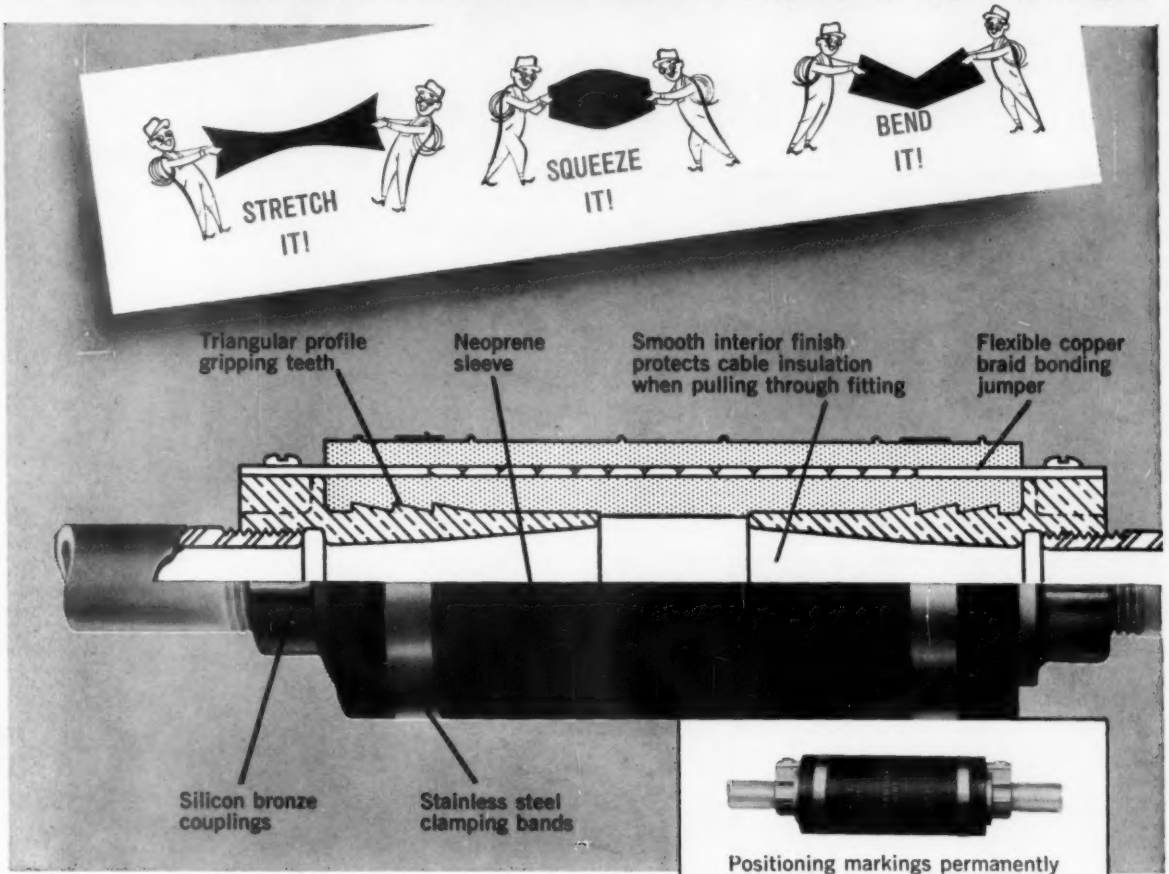
PERMACEL®

PERMACEL *New Brunswick, N. J.* TAPES • ELECTRICAL INSULATING MATERIALS • ADHESIVES

make GraybaR *your shopping center for . . .*

GraybaR Everything Electrical GraybaR ELECTRIC COMPANY

For Positive Freedom of Conduit Movement—
THE ALL NEW O.Z. TYPE "DX" EXPANSION & DEFLECTION FITTING!*



Here's the newest addition to a long line of O.Z. expansion and deflection fittings — the O.Z. Type "DX"! Of completely new design and construction, it provides fitting features *never found before!*

The all-new Type "DX" is designed principally to compensate for expansion, contraction, and deflection in conduit across expansion joints in concrete, but it also may be used as a vibration damper.

For more information on this rugged, corrosion-proof, Weathertight fitting, call your local O.Z. distributor or write direct to the company.

Positioning markings permanently and clearly molded on sleeve assure proper placement of fitting in expansion joint

- **Compensates for expansion, contraction, deflection; may be used as a vibration damper.**
- **¾" expansion and contraction movement.**
- **30° angular deflection from the normal in any direction.**
- **Corrosion-proof!**
- **Weathertight!**

*Patent Pending

O.Z. ELECTRICAL MANUFACTURING CO., INC.

262 BOND STREET • BROOKLYN 17, N. Y.

- CAST IRON BOXES
- CABLE TERMINATORS
- POWER CONNECTORS
- SOLDERLESS CONNECTORS
- GROUNDING DEVICES
- CONDUIT FITTINGS
- INTERLOCKED ARMOR CABLE FITTINGS

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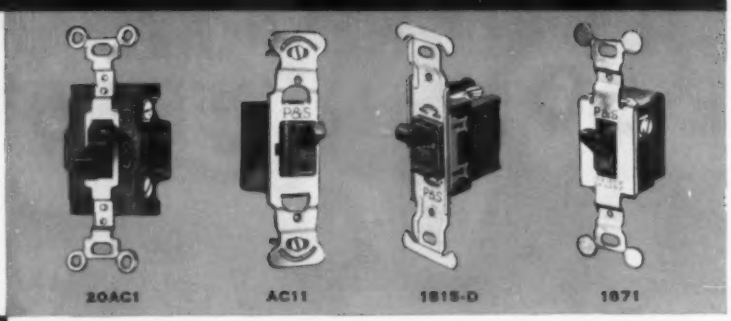
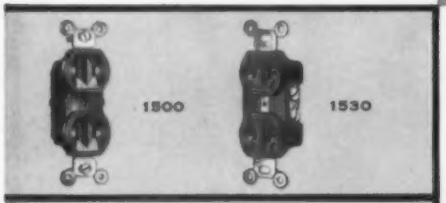
THERE'S A P&S QUALITY WIRING DEVICE FOR EVERY REQUIREMENT

SWITCHES – A complete line . . . heavy duty 20 Amp AC . . . T-Rated . . . residential . . . a switch for every job.





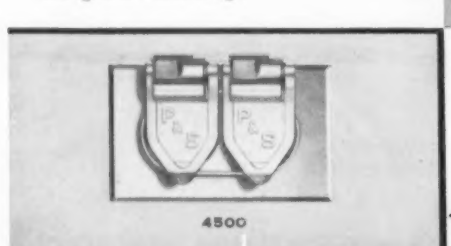
OUTLETS – A range to meet every need. Shown are the 1500 with time-saving screwless terminals and the 1530 T-Slot with dead back.

3-WIRE GROUNDING DEVICES – A full line of outlets, caps, connectors in 125 V and 250 V types.

POLARIZED DEVICES – Available in 2, 3, and 4-wire . . . 15 and 20 Amps . . . outlets, caps and connectors . . . all built to take a beating.

TURNLOK – Sturdily built outlets, caps, connectors . . . 2, 3, and 4-wire, 10 and 20 Amps.

DESPARD LINE – The original and only complete interchangeable line . . . super-compact, highly versatile. Combinations assemble in seconds with P&S-Despard camstrap.



WEATHERPROOF COVER – Makes any standard duplex outlet a weatherproof device.

Standardize on Pass & Seymour Devices

P&S

PASS & SEYMOUR, INC.
SYRACUSE 9, NEW YORK
60 E. 42nd St., New York 17, N. Y. 1440 N. Pulaski Rd., Chicago 51, Ill.
In Canada: Renfrew Electric Limited, Renfrew, Ontario

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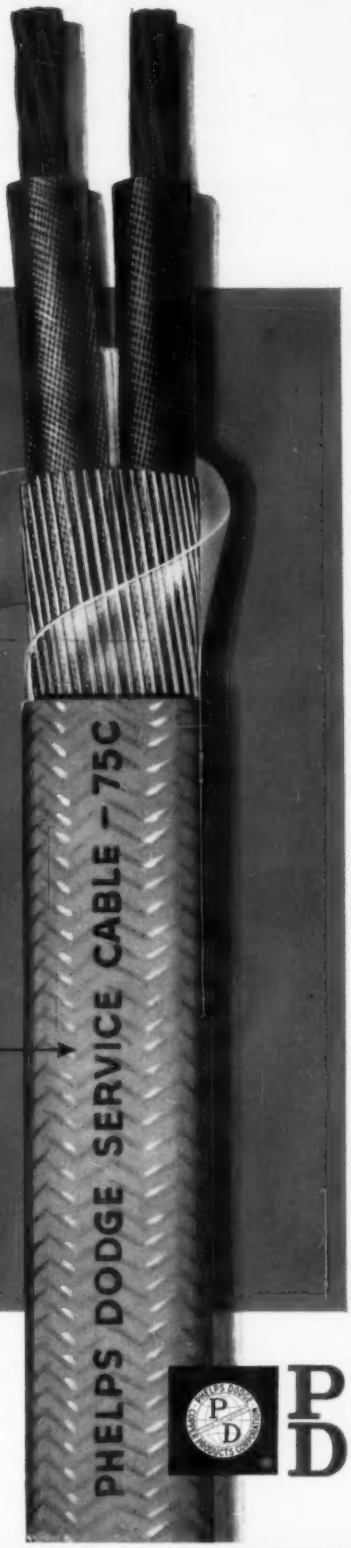
Electrical Contractors acclaim

Phelps Dodge SE-U Cable with Mylar* tape!



The new SE-U type cable with Mylar tape and an improved outer compound, developed and introduced by Phelps Dodge, has received enthusiastic approval from electrical contractors and chief state electrical inspectors. Here are some comments about this remarkable cable picked at random from field reports:

"It is much more flexible . . . ease of stripping is made easier on this new type . . . a definite improvement over the old type."

"We found it to be superior in several ways to the kind of cable we have been using. It is more flexible and easier to strip . . ."

"Phelps Dodge entrance cable . . . proved to be much more than we could possibly expect. The ease of 'skinning' and handling were what we have been looking for in an entrance cable."

MYLAR TAPE FOR
More flexibility • Better moisture resistance
Lower shipping weight • Lighter, less bulky cable

GRAY COMPOUND FINISH
gives better cable appearance; will not stick in hot weather, will not crack or flake in cold weather.

Phelps Dodge entrance cable with Mylar tape has received Underwriters' Laboratories Approval.

See your Phelps Dodge Distributor!

*Mylar is Du Pont's registered trademark for its brand of polyester film.

PHELPS DODGE COPPER PRODUCTS
CORPORATION

SALES OFFICES: Atlanta, Birmingham, Ala., Cambridge, Mass., Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Dayton, Denver, Detroit, Fort Wayne, Greensboro, N.C., Houston, Indianapolis, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D.C.

PD

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Everything Electrical GraybaR

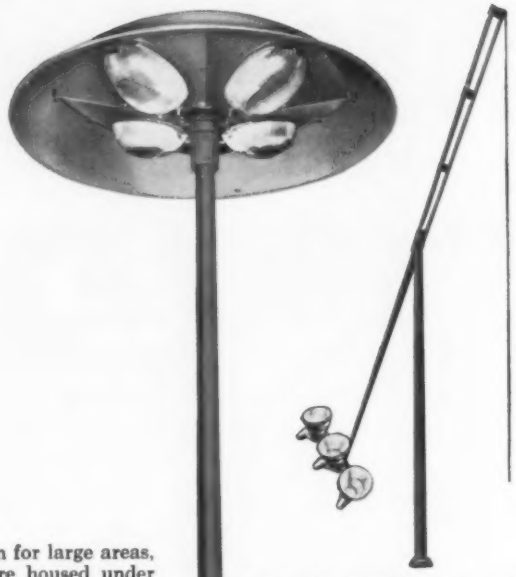
For the best in outdoor lighting see your Revere wholesaler

No matter what your outdoor lighting requirements, Revere has the dependable, easy-to-install lighting fixtures needed for your job.

Because Revere distributes through competent, experienced wholesalers, you are assured the benefits of helpful, friendly service when you buy Revere equipment.

Backing up Revere's extensive selection of lighting equipment are years of your wholesaler's experience — specialized experience in outdoor lighting problems to help you save time and pick the best fixtures for your lighting installation.

For your next outdoor lighting job, specify Revere, and see a lighting specialist — the Revere electrical wholesaler serving your area.



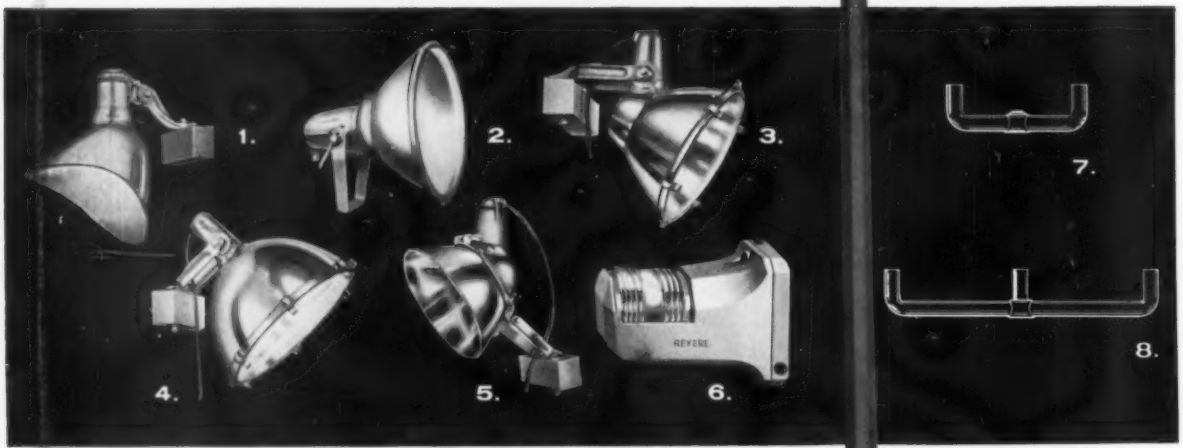
Ultra-Lite at right is Revere's latest in outdoor mercury illumination for large areas, such as parking lots and parks. Four 400-watt mercury lamps are housed under an attractive metal "dome". Lamps are positioned to provide a "square" light pattern. Light patterns overlap to increase fringe intensities and provide greater light uniformity. Ultra-Lite's large coverage reduces pole requirements 50 to 75%.

Heavy duty hinged pole for safe, economical lamp maintenance at ground level. Eliminates need for boom trucks or ladders. Sturdy construction. Weather-resistant.

Tapered, rigid octagonal pole at left is fabricated of 11-gauge *Cor-Ten* corrosion-resistant steel. Continuous welding, base to top.

Revere OUTDOOR LIGHTING

Revere Electric Mfg. Co. • 7420 Lehigh Avenue • Chicago 48, Illinois (In suburban Niles)
Long Distance Phone: NIles 7-6060 • Chicago Phone: SPring 4-1200 • Telegrams: WUX Niles



1. 3800 Series Eliptor floodlights for 300 to 1500-watt incandescent lamps. Aluminum or vitreous-fired, porcelained enameled steel in selection of colors. Degree marked for settings.

2. 7100 Series open or enclosed floodlight for 200 to 1000-watt incandescent lamps. Wide or narrow beam Alzak aluminum reflectors.

3. 4200 Series enclosed flood for efficient lighting of large areas. Wide or narrow beam reflectors. Dust-tight and weather-proof. For 750, 1000, or 1500-watt incandescent lamps. Swing-over feature for easy servicing.

4. 7400 Series floodlight for 1000-watt mercury lamps. Provides exceptionally high light output. Choice of clamp or hinge type 24-inch lens holders. Weatherproof, lightweight.

5. 2000 Series 20-inch flood for 750, 1000, or 1500-watt PS-52 lamps. Rear section access for relamping. 20° or 50° spread. Alzak aluminum reflectors. Permanent watertight seal.

6. 3151 Series underneath floodlight for even lighting on plane surfaces. Weatherproof, and insect-proof. Flat surface mounting.

7. Bracket for two floodlights of standard steel pipe with pipe stubs welded for one piece construction. Bracket threaded at bottom center to accommodate 2 or 3-inch mounting pipe.

8. Bracket for three floodlights, same construction as above. Pipe stubs centered on 2-foot spacings. Revere floodlight brackets are available from stock for up to 10 floodlights.

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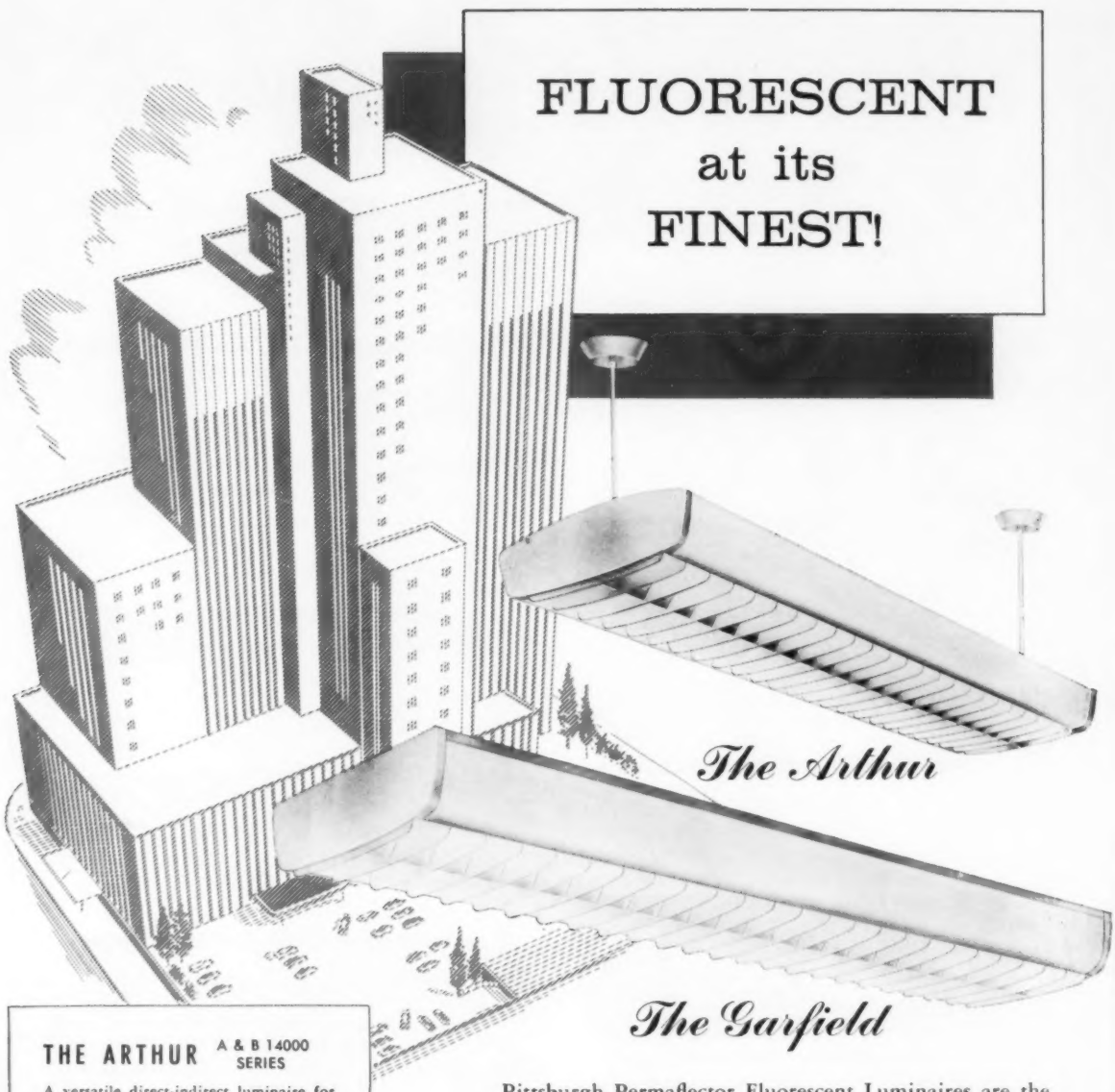
FLUORESCENT at its FINEST!



THE ARTHUR A & B 14000 SERIES

A versatile direct-indirect luminaire for individual or end-to-end pendant mounting. The Arthur is available in 4-foot and 8-foot lengths, in 2 or 4-lamp models. Trim, shallow lines, all white finish, diffused polystyrene side panels and 35° x 35° shielding.

THE GARFIELD A & B 13000 SERIES

The 2 and 4-lamp Garfield is a companion unit to the Arthur, except that it has been especially designed for surface mounting. The long, low lines give it a "built-in" look and make it ideal for surface mounting on low ceilings. Diffusing polystyrene side panels and 35° x 35° shielding.

50th Anniversary Pittsburgh 1909-1959

Pittsburgh Permaflector Fluorescent Luminaires are the *first* choice among men who recognize the need for versatility and flexibility in lighting equipment. That's why so many of today's buildings are illuminated with Pittsburgh Permaflector Equipment. In Pittsburgh Luminaires you find modern styling, plus high overall efficiencies . . . and you find a *complete* selection of equipment that is economical in initial cost, easy to install and maintain, and gives maximum efficiency through its long service life.

WRITE The 12-page Bulletin N tells the full story of the gracefully styled Garfield and Arthur Luminaires for direct or indirect lighting.

PITTSBURGH REFLECTOR COMPANY

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Gipsner Everything Electrical GraybaR Electric Company

PWC INSULATED WIRES, CABLES AND CORD SETS

BUS DROP CABLE

Flexible and extensible branch circuits for machine shops.

APPLIANCE WIRING MATERIAL

90° and 105°C Underwriters' Laboratories listed.

TYPE ST YANKEE SAFETY CORD

UL listed Type ST and SJT in Chrome Yellow.

GASOLINE AND OIL RESISTANT WIRE

.UL approved — sizes # 14 to 500 MCM.

TYPE ST OIL-PROOF

Underwriters' Laboratories listed Oil Proof Type ST and SJT.

STATION CONTROL CABLE

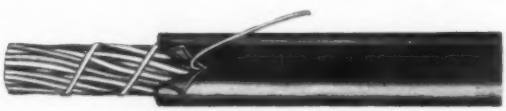
Conforms to IPCEA Standards, column "B" insulation.

IMSA CONTROL CABLE

Conforms to IMSA Specifications 19 and 20 — 1956.

PARALLEL POWER AND MINE CABLE

Listed by U. S. and Penna. Bureau of Mines.

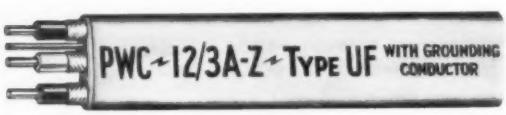


INSIDE TELEPHONE CABLE

Commercial establishments and special plan wiring systems.

FLEXIBLE POWER CABLE

Conforms to IPCEA Standards for 600 volt cables.



A-Z TYPE UF

Single conductor No. 14 to No. 4/0 Multiple conductor No. 14 to No. 6.

FLEXIBLE CABLE

Conforms to UL and IPCEA Standards.

RANGE AND DRYER CORD SET

Underwriters' Laboratories listed.

CUSTOM MADE CORD SETS

Cord sets manufactured to your specifications.

For additional information and special constructions contact your electrical distributor or the PWC General Office

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JEWETT CITY, CONNECTICUT

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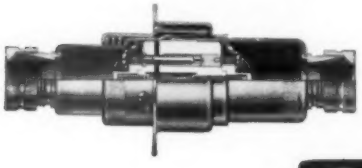
Everything Electrical GraybaR ELECTRIC COMPANY

Industry's most adaptable—most versatile general duty plug and receptacle line . . . for power, control, electronic and thermocouple circuits in U/L circuit breaking ratings up to 20 amperes 250 volts, D.C.—460 volts, A.C.

IMPROVED TRIPLOC® CONNECTORS



Pyle-National's Triploc is the finest line of connectors on the market today, in its electrical rating and general application class. In the Triploc compact size and price range, no other connector can approach its rugged construction for industrial service . . . or equal the hundreds of optional shell assembly combinations possible with the standard 1 to 12 pole interchangeable and reversible contact inserts. Combinations up to 48 poles are easily assembled in enlarged shells which gang 2, 3 and 4 standard inserts. Water-tight shells also 2-wire and 3-wire fusible plugs are available.

New, Enlarged Wiring Space. Triploc's cadmium plated, pressed steel shells are of strong, low-weight design and provide ample wire terminating space for all inserts.

Self-Locking Triploc Plugs are available with automatic cord-strain release or with manual twist release only.

Wide Choice of Wire Terminals. Contact inserts are available with binding screw terminals—back wired, side wired, or pressure eyelet type; solder well type; crimp type.

Midget Triploc Round Prong Series is available in 2, 3 and 4-pole ratings of 20 amperes, 125 volts A.C.; 15 amperes, 125 volts D.C.; 10 amperes, 277 volts A.C.

SINCE 1897

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Sold nationally through authorized distributors. Write for bulletin 1252-B-C.

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GRAYBAR Everything Electrical GraybaR ELECTRIC COMPANY

ANCHOR ANYTHING TO MASONRY *with these* RAWL PRODUCTS:

BRANDED RAWLPLUGS

FOR SHEET METAL SCREWS • STANDARD WOOD SCREWS • LAG SCREWS

Rawlplugs are the only truly universal masonry anchors . . . they hold securely in *any* masonry material. They won't fracture brittle or fragile material—have been installed in glass!

Rawlplugs are adaptable to all types of gimlet-pointed sheet metal screws, standard wood screws or lag screws. Diameters and lengths available for every screw size from #6 through ⅜".

Measured in terms of holding power or size of fastener, Rawlplugs require a smaller drilled hole than any other masonry anchor. The "elastic-compression" expansion that gives the Rawlplug its holding power soaks up vibration . . . no creeping or failure.

RAWL SCRU-LEADS

Lead Screw Anchors for sheet metal screws and standard wood screws. The most holding power possible with any lead screw anchor.

Exclusive Rawloy, lead alloy especially developed for masonry anchors, used for ease of installation and sure holding power.

Flange permits use in hollow material.

RAWL LAG-SHIELDS

Lag Screw Expansion Shields

The Rawl Lag Screw Shield is a completely rustproof precision-cast lag shield made of durable alloy.

Ideal for all masonry fastening, especially where problem masonry is encountered.

Horizontal fins prevent shield from turning in hole.

Tapered outside rings have tremendous biting power.

RAWL DRIVES

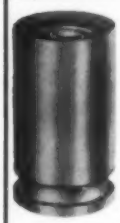
Rawl-Drives are the world's only one-piece expansion bolts—they drive like a nail; hold like a bolt.

Fast, easy installation—no hole spotting or layout needed. Drill through fixture hole, hammer Rawl-Drive home through fixture hole.

RAWL SPRING-WINGS

Automatic Spring Action Toggle Bolts

Rawl Toggle Bolts are rustproof and have a positive automatic spring action for easy installation in Hollow Walls, Pressed Board Walls, Tile, Sheet Metal, etc.



RAWL CALK-INS

Machine Screw Caulking Anchors

Improved machine screw anchor. Sleeve is precision-cast of Rawloy, exclusive lead alloy especially developed for masonry anchors—Just soft enough for easy, complete caulking and hard enough for tremendous holding power.

FREE caulking tool included in every box.

RAWL HAMMER-SETS

Non-Caulking Anchors For Machine Bolts

Shallower hole required than all other machine bolt anchors. Excellent for heavy holding requirements in hollow material—cement and cinder block, hollow tile, etc. Can be used at any depth in a hole, thus can be set beneath plaster or other soft surface materials.

RAWL MULTI-CALKS

The Heavy-duty Bolt Anchor

A caulking masonry anchor for the really big jobs.

Caulking sleeve cast of Rawloy, the masonry anchor alloy, for complete caulking and secure holding.

Lugs on cone prevent its turning as nut is tightened on bolt.

Your GRAYBAR representative is TRAINED to help you solve MASONRY ANCHORING PROBLEMS

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SAVE TIME and MONEY with these RAWL DRILLS and ACCESSORIES

All Rawl percussion drills are three pointed for easy sharpening and faster drilling.

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FORGED TAPER-SHANK DRILLS for POWER HAMMERS (T/S)

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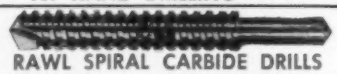

RAWL SPIRAL CARBIDE DRILLS

RAWLDRILL Accessories

RAWL DRILL-HAMMER

Quickly converts a ¼" high speed electric drill to a fast power hammer.

Weight—2¾ pounds. Weight of blow—adjustable to "light," "medium" or "heavy." Construction — only three moving parts all of hardened steel. Designed to withstand the most severe treatment. Capacity—Rawl #14 adapter for No. 6 (5/32") to No. 14 (9/32") Rawldrills (M/T or R/T). Rawl #20 adapter for No. 16 (5/16") to No. 20 (⅜") Rawldrills (M/T or R/T).

In order for GRAYBAR men to be of more service to you, they have attended RAWLPLUG "Anchorama" TRAINING school. They know which anchor best fits your application and why. Ask your trained GRAYBAR salesman for his recommendations.

The RAWLPLUG COMPANY, Inc.
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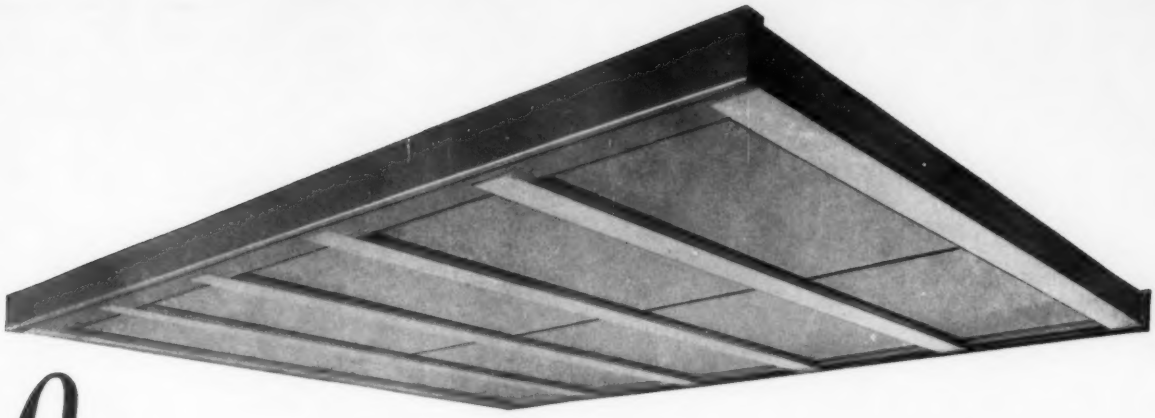

Color-ceil®

.....THE "FLOATING PANEL" OF COLOR AND LIGHT

that provides

HIGH LEVEL LIGHTING WITH COMPLETE SEEING COMFORT

EXCLUSIVE FEATURES

1. A practical method of obtaining illumination in commercial interior with complete flexibility of . . .

   50 footcandles with Slimline lamps
   100 footcandles with High Output lamps.
   200 footcandles with Power Groove lamps

2. Introduces color without sacrifice in efficiency and without distortion of color value of light.
3. Easy to install—easy to maintain.
4. Lowest in cost for any large area lighting system on a cost per footcandle per square foot basis.
5. Provides complete flexibility in dimension.
6. Offers concealment for unsightly ceiling beams, ducts and pipes.
7. Provides comfortable environment with complete shielding of light source and low brightness of luminous parts of fixture.

Send for Complete Details

THE COLOR-CEIL DESCRIPTIVE FOLDER

A four-color folder containing important facts on Color-Ceil—performance data, mechanical details, applications, etc. Requests on company letterhead promptly answered.

Color-Ceil is a "Floating Panel" luminaire specifically developed for use with Power Groove fluorescent lamps. It embodies an entire new concept of design to provide lighting levels of 200 footcandles or more—efficiently and with complete freedom from glare and unpleasant brightness contrast.

Color-Ceil also adds a new dimension in lighting—COLOR—in the form of tinted plastic louvers, softly illuminated by an indirected system of lighting.

The unique combination of design features of Color-Ceil has been judged by experts to be one of the most significant lighting developments of recent years. Despite its advanced design which eliminates an inherent disadvantage of prevailing system—the monotony of row after row of lights, Color-Ceil costs less per footcandle per square foot than many other lighting systems and provides more light for seeing, selling or working.

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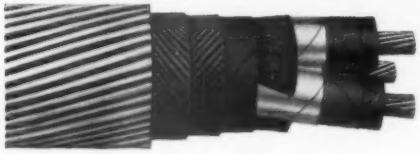
Mining engineers everywhere who insist on first line quality are careful to specify Simplex-TIREX heavy-duty cables. The durability for which TIREX is famous results from curing and conditioning advanced compounds in a lead mold. This process, originated by Simplex in 1920, has never been surpassed.

. . . in Power and Lighting



Anhydrex Insulated Submarine Cable

Simplex-ANHYDREX and ANHYDREX XX Insulated cables are designed for installation in any environment. They operate dependably in circuits requiring up to 35 Kv; permit conductor temperatures as high as 90°C. wet or dry; and can be supplied with any desired outer covering, round wire armor, C-L-X continuous metal sheath and Simplex Condex interlocked armor.

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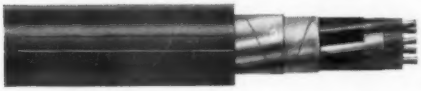

Railroad Signal Cable

Railroad men rely heavily on Simplex cable for every wiring application, including Power, Control, Communication, Signal, Diesel Wire, Car Wire, and portables. This is especially true where Signal Cable is concerned. Their sense of responsibility both to the road and to the public demands that they use only the finest.

NEW C-L-X . . . in Industrial Construction

C-L-X Sheath with Thermoplastic Cover

Plant Engineers may specify Simplex power, control and communication cables – or combinations of these – on the basis of electrical requirements only. Simplex C-L-X provides completely sealed mechanical protection.

In addition, C-L-X (the metallic duct with built-in cable) gives not only the protection usually provided by rigid ducts or conduits – it gives pliability too. Because C-L-X is a completely closed system, it prevents damage from nearly all liquids and many harsh chemicals.

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The reliability, safety and efficiency of any portable electric tool depends on the integrity of its cord or cable. Simplex-TIREX portable cords and cables are practically indestructible when used to do the work for which they are designed. TIREX portable cables are also cured and conditioned in lead.

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Square D Vertical Action Magnetic Starters Sizes 0, 1, 2, 3, 4 and 5

ONLY SQUARE D GIVES YOU ALL 5

1·*QUICK* INSTALLATION!

No groping or fumbling. Square D gives you lots of wiring space, plenty of knockouts, handy and clearly marked pressure wire connectors.

2·*TOP* PERFORMANCE!

No needless downtime from coil burnout, mechanical binding, contact freezing. Square D gives you an extra-capacity magnet with a tough and cool-operating encapsulated coil to handle additional poles and interlocks—a guided single moving part—big silver cadmium-oxide contacts with strong finger springs—arcing yokes on larger sizes.

3·*REAL* OVERLOAD PROTECTION!

No change in trip characteristics because of mismatched parts supplied separately for field assembly, no distortion of heater in installation. Square D gives you melting alloy unit construction—factory-assembled and individually tested for bull's-eye accuracy. Also bi-metal and magnetic designs for automatic reset or adjustable trip applications.

4·*EASY* INSPECTION and MAINTENANCE!

No starter is "maintenance-free." But Square D makes the job easy. Inspection is a breeze. You don't have to remove wiring for contact replacement or take the starter out of the enclosure to change coils.

5·*WIDE-RANGE* ADAPTABILITY!

No need for excessive inventories to avoid costly waiting for non-standard arrangements. Square D provides "off-the-shelf" kits for changing contacts and coils, adding pushbuttons, selector switches, and up to 4 double-throw auxiliary circuits.

STARTERS and other Square D Products are distributed by GRAYBAR

SQUARE D COMPANY

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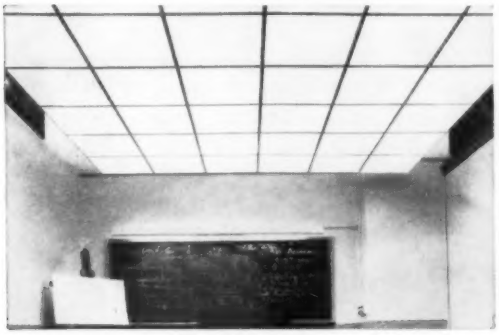
Smithcraft large element lighting

"WELL, HOW WAS I TO KNOW WE WOULDN'T NEED THE HEAVY STUFF TO INSTALL IT?"
(the moral: NEXT TIME JUST BRING A PAIR OF PLIERS AND A SCREWDRIVER.)

The easiest "big fixture" to install ever designed! Large Elements are pre-assembled and wired; they are simply removed from the carton and mounted like any other fixture. To form large "floating areas", elements are bolted together in both directions, providing all the effect and utility of overall ceiling lighting. And there are no costly wall attachments! Excellent for high level illumination with maximum comfort, uniform low brightness and a modern architectural appearance.

ANOTHER SMITHCRAFT FIRST! Smithcraft Large Element Lighting . . . the large area luminaire with POWER-GROOVE Lamps! For very high level illumination in department stores, offices, laboratories, etc.



A "FLOATING" CEILING. With five different sizes of units from 4'x4' to 8'x6', a wide variety of areas and patterns are possible. Modules have exact dimensions in both directions.

FREE! The Smithcraft LIGHTESTER . . . enables your customers and prospects to "grade" their own lighting! A creative selling aid for you! For your sample LIGHTESTER, fill out and mail the coupon.

EC-2

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☐ Please send me a FREE sample of LIGHTESTER and complete information on how I can use the "LIGHTESTER" to increase my sales.

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America's finest fluorescent lighting

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CHELSEA 50, MASSACHUSETTS

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FOR THE EXACT TOOL ON THE EXACT JOB CHOOSE

Powerful Thor Electric Tools

DRILLS Thor's series of universal electric drills have earned a reputation for high quality and outstanding performance. Stand-outs wherever durability and reserve power are desired. All ball-bearing construction and Thor-built motors assure long life on the job. In ¼" to 1¼" capacities. Complete range of speeds, angle attachments and accessories.

IMPACT WRENCHES You name the job, Thor has the impact wrench to fit. All Thor wrenches are reversible. Deliver two hard rotary blows for every spindle revolution. No torque reaction. Cannot stall or burn out. Prices start at a low $94.50 for a ½" drive wrench. Heavy duty ½" and ⅝", angle attachments, accessories, kits available.

HAMMERS Here's a pair of Thor utility hammers unmatched for quality or versatility. Model 15 air hammer has exclusive stop rotation. Four tools in one—demolition tool, drill, clay digger and chipping hammer. Weighs only 15 lbs. Need an electric hammer? Thor's U-100 hammer breaks up concrete, gouges or shapes wood—scales metal, drills stone, concrete.

THOR REVERSIBLE DRILLS—Heavy-duty Thor EJ9RT reversible drill has wide use by telephone and utility company linemen. Reversible feature is highly important for fast, easy withdrawal of bit from hole.

GRINDERS You can remove more metal per minute on the toughest jobs with Thor grinders. The secret is the smooth transmission of power through highest quality anti-friction bearings. Straight grinders in 4", 5" and 6" sizes. Angle grinders with 7" or 9" depressed centers for cut-off operations. Angle grinders in 4" and 6" cup wheel type for general grinding.

SAWS You can cut your lumber and your costs faster with any of the seven powerful Thor saws. Save costly labor time—build up profits per job. Just look at the selection you get: two 6¼" models, two 7½" models, 8¼", 10" and 12" models. Prices start at a low $49.95. 9 blade types and a variety of abrasive discs are offered as accessories.

For the tools that do more, you'll choose Thor every time because building quality tools has been Thor's only business for 64 years. We know how to make tools better and how to service them better. Thor maintains service facilities in twenty-three cities and sells only through qualified distributors. Choose Thor—for the exact tool on the exact job. Thor Power Tool Company, Aurora, Illinois.

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TOOLS

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*Pat. Pending

(CATALOG NO. G)

—takes the work out of grounding switch and outlet boxes used with non-metallic sheathed cables #10, 12 and 14.

Comes to you in a handy
cigarette-type package;
50 to the package, 1000 to the carton.

WRITE FOR FREE SAMPLE!

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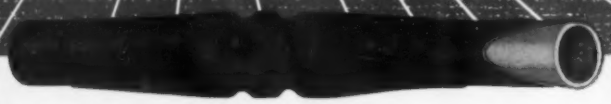

"DEKORON-COATED" E.M.T.

"Dekoron®-Coated" E.M.T., the plastic armored raceway recommended for use in severe corrosive conditions of service outlasts standard conduit 10 to 1. Easy to install, requires no special tools, no special fittings.

GALVITE RIGID STEEL CONDUIT

GALVITE® (Blue Label) heavy wall galvanized conduit has a special coat of baked-on lacquer inside and out for corrosion-resistance and long life.

ENAMELITE RIGID STEEL CONDUIT

ENAMELITE® (Red Label) heavy wall conduit is protected inside and out with a baked-on coating of tough, wear-resistant enamel for greater protection against moderate corrosive action.

REPUBLIC ELECTRUNITE E.M.T.

Brand new on-the-job benefit built-in . . . Republic ELECTRUNITE® E.M.T. with exclusive SILVERSLICK inside finish makes wire-pulling up to 37% easier. Wire pushing is easier, too. This new product improvement combined with ELECTRUNITE's exclusive "INCH-MARKS"® for easier measuring, and "GUIDE-LINES" for easier bending are all reasons why . . . the *best* now costs *even less* installed.

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Republic builds, too

Here's dramatic proof: Contracts have been let for new production facilities to meet your increasing demand for Republic ELECTRUNITE® Electrical Metallic Tubing.

Republic is building production capacity for the future. On your future jobs, use Republic ELECTRUNITE E.M.T. or Rigid Steel Conduit, as well as Republic's plastic armored raceways.

Because . . . THE BEST COSTS LESS INSTALLED.

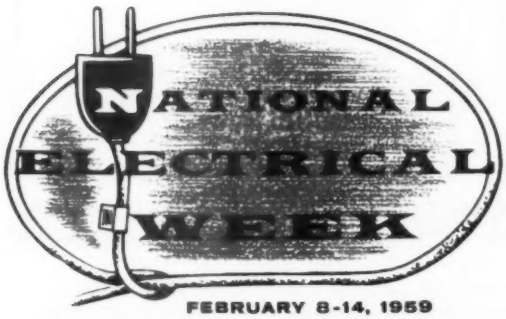
"DEKORON-COATED" RIGID STEEL CONDUIT

"Dekoron-Coated" Galvite Rigid Steel Conduit—the heavy wall raceway that shrugs off corrosion. Tough coating of polyethylene encases the conduit in an end-to-end armor for protection against severe corrosion.

REPUBLIC BENDING TOOLS

Republic Bending Tools are designed and engineered to help the contractor make accurate predetermined bends in Republic raceway installations. Avoid costly "wows", wasted time, and wasted material.

REPUBLIC STEEL



FEBRUARY 8-14, 1959

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
DEPT. C-6888
212 EAST 131st STREET • CLEVELAND 8, OHIO

Please send additional information:

- ☐ Republic ELECTRUNITE E.M.T. with SILVERSLICK Finish
- ☐ Republic ELECTRUNITE "Dekoron-Coated" E.M.T.
- ☐ "Dekoron-Coated" Rigid Steel Conduit
- ☐ GALVITE
- ☐ ENAMELITE
- ☐ The Bending System, Booklet S-D

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Company_____

Address_____

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AMAZON TAPE

Amazon A.S.T.M. tapes are designed for the severest kind of service — where top quality is of prime importance.

AMAZON FRICTION TAPE is of unusually high and uniform quality. Meets Government Specification HH-T-101 Grade A. The long fibers of the rubber compound used afford superior adhesion and make the tape an excellent insulator.

AMAZON RUBBER TAPE withstands a dielectric test of at least 350 volts per mil of thickness . . . meets Government Specification JJ-T-11C. The very high natural rubber content of this tape makes it extremely elastic and it is self-vulcanizing into a solid waterproof joint.

There's a Graybar tape
FOR EVERY JOB

Tapes for every electrical requirement are conveniently available from your nearby Graybar office or warehouse. Made to rigid Graybar specifications these fine tapes have a record of superior performance, long service, and outstanding value. For over forty years they have been the choice of industry and careful workers everywhere. Check the types shown on this page and see which are best suited to your own particular needs.

VICTOR TAPE

for general commercial use requiring a high grade tape

VICTOR FRICTION TAPE has a strong tacky friction, ages well and is virtually free from pinholes. Careful inspection assures a uniform quality.

VICTOR RUBBER TAPE is second in quality only to Amazon. It withstands dielectric test of 300 volts per mil of thickness — gives excellent service both indoors and out.

STICKA FRICTION TAPE

STICKA will be your choice for a hundred and one everyday jobs where a thoroughly reliable and economical tape is indicated. Order it by the 60 foot roll or in the convenient ten-roll shop package.

DEPEND ON ALL **Graybar** TAPES FOR THE BEST IN SERVICE AND VALUE!

FREE! **SAMPLE TAPE ROLLS—Graybar will be glad to mail you sample rolls of Amazon Rubber Tape and Sticka Friction Tape. Each roll contains 30 feet of tape—enough for an on-the-job trial. Write for them today!**

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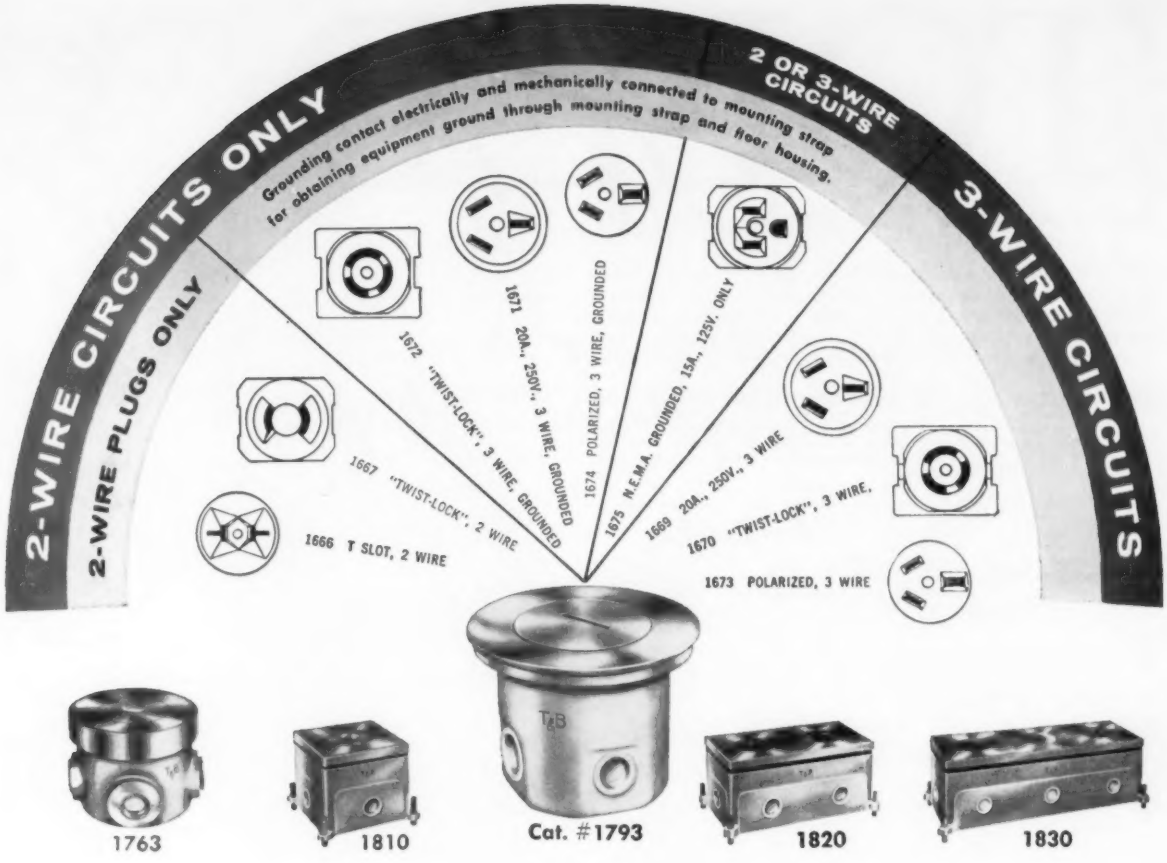
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2-WIRE PLUGS ONLY
Grounding contact electrically and mechanically connected to mounting strap for obtaining equipment ground through mounting strap and floor housing.
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1669 20A., 250V., 3 WIRE
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1763
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New! T&B floor box receptacle

MATCHES YOUR CIRCUIT WIRING AND THE PLUG ON YOUR EQUIPMENT

Here's a convenient money saver from T&B . . . designed to make the use of many types of receptacles easier and more readily available. T&B receptacles (there's one for every need) fit all T&B floor boxes . . . and they can be changed in a matter of minutes should you later install equipment which requires a change in receptacles.

For full information on T&B floor boxes and receptacles, contact your T&B distributor today – he will show you how to save money on installed costs, save time, and safety-ize your job with T&B floor box receptacle combinations.

LOOK FOR THE SIGN – AUTHORIZED DISTRIBUTOR T&B ENGINEERED

IT'S THE MARK OF AN AUTHORIZED **T & B** DISTRIBUTOR

The complete line of T & B fittings for conductors and raceways is sold only by recognized electrical wholesalers. It's our way of assuring you the service and savings of a friendly local source. Call him for all your electrical needs. T-510

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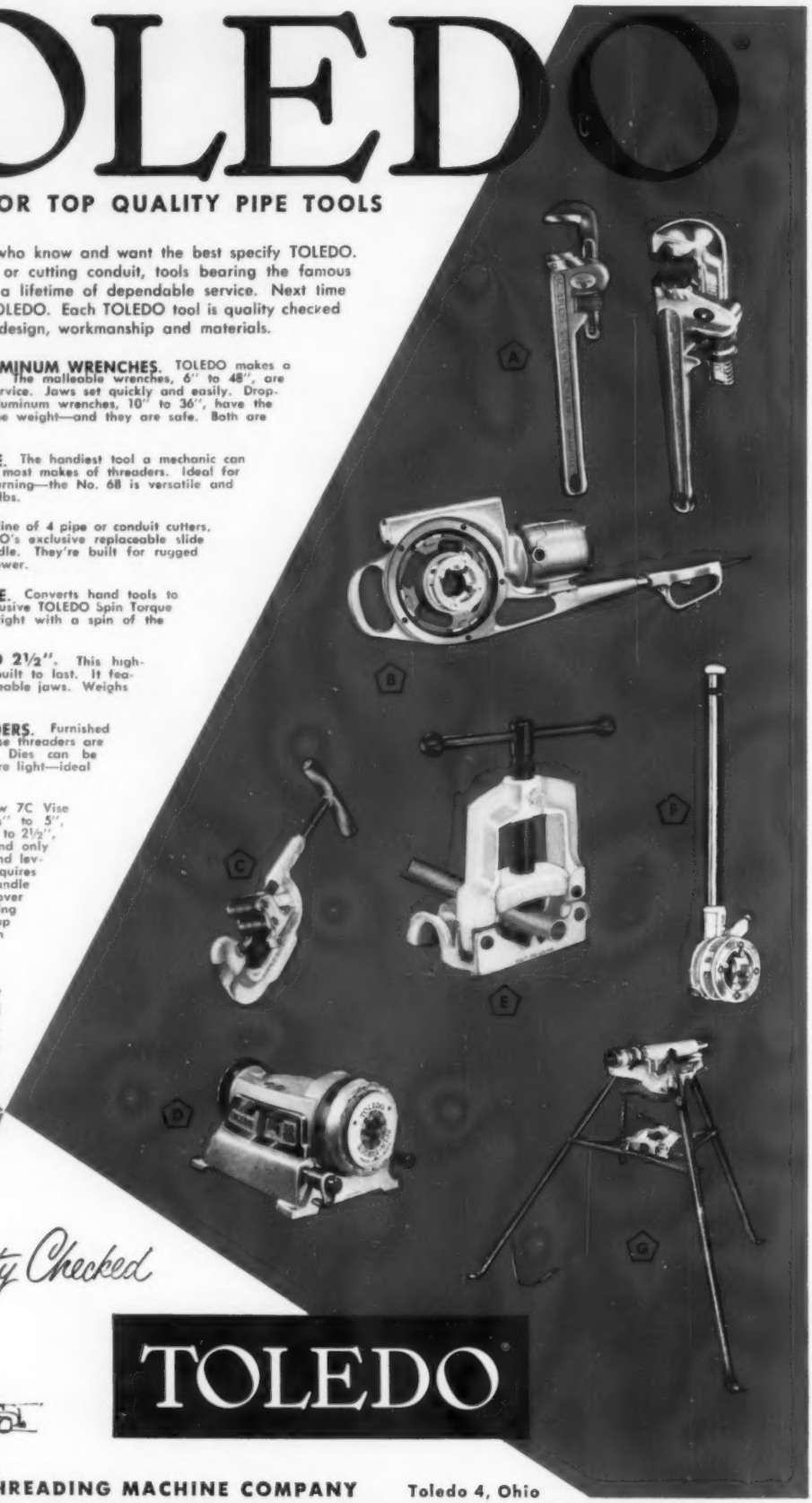
TOLEDO

THE STANDARD FOR TOP QUALITY PIPE TOOLS

Men in the electrical industry who know and want the best specify TOLEDO. They know that for threading or cutting conduit, tools bearing the famous TOLEDO label will give them a lifetime of dependable service. Next time you buy pipe tools, insist on TOLEDO. Each TOLEDO tool is quality checked to guarantee you the best in design, workmanship and materials.

- **MALLEABLE AND ALUMINUM WRENCHES.** TOLEDO makes a complete line of wrenches. The malleable wrenches, 6" to 48", are strong—built for rugged service. Jaws set quickly and easily. Drop-forged for strength, the aluminum wrenches, 10" to 36", have the strength of steel at half the weight—and they are safe. Both are unconditionally guaranteed.
- **NO. 68 POWER DRIVE.** The handiest tool a mechanic can own, adaptable to operate most makes of threaders. Ideal for pulling, lifting, cranking, turning—the No. 68 is versatile and powerful—weighs only 33 lbs.
- **PIPE CUTTERS.** A new line of 4 pipe or conduit cutters, ⅛" to 2", features TOLEDO's exclusive replaceable slide plate and form-fitting handle. They're built for rugged service. Both hand and power.
- **NO. 88 POWER DRIVE.** Converts hand tools to power. Equipped with exclusive TOLEDO Spin Torque Chuck that holds conduit tight with a spin of the hand-wheel. ⅛" to 2".
- **NO. 22 VISE. ⅛" TO 2½".** This high-quality, low-cost vise is built to last. It features Acme threads, replaceable jaws. Weighs only 12 lbs.
- **DROP HEAD THREADERS.** Furnished in 3 sizes, ⅛" to 2", these threaders are ideal for close corners. Dies can be changed in seconds. They're light—ideal for conduit.
- **VISE STANDS.** The new 7C Vise Stand with chain vise, ⅛" to 5", and 7Y with yoke vise, ⅛" to 2½", contain many features found only with TOLEDO . . . compound leverage applied to chain requires minimum turns on screw, handle on top, conduit benders over rear leg, rugged steel folding tray. Easy to carry—set up—they won't collapse when in use.



TOLEDO makes many other hand or power pipe and conduit tools. For more information, write for the free catalog showing TOLEDO's complete line.

Quality Checked

TOLEDO

THE TOLEDO PIPE THREADING MACHINE COMPANY Toledo 4, Ohio

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NO FITTINGS do the Job LIKE TOMIC!

Not A Boast! Not A Claim! But A Proven Fact!

America's most successful contractors use Tomic fittings exclusively. Why? Every fitting is a unique patented design, engineered to solve the tough problems that have troubled the industry for years. They do the job easier, better — **will save you money.**

Pat. No. 2784010

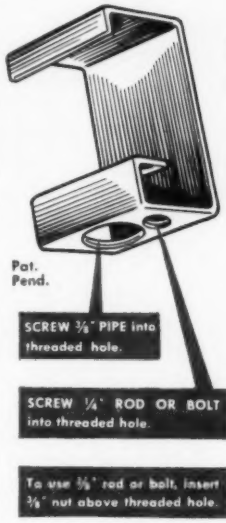
An Extra Twist Locks It In Place

NEW NO. 300 3/8" *Twist-In* GREENFIELD CONNECTORS

- Assures positive ground
- Will not shake loose
- Smooth interior and rounded throat
- Twists inside—locks in place
- All steel construction

ALSO AVAILABLE

No. 301—½ Inch • No. 302—¾ Inch


Pat. Pend.
SCREW 3/8" PIPE into threaded hole.
SCREW 1/4" ROD OR BOLT into threaded hole.
To use 3/8" rod or bolt, insert 3/8" nut above threaded hole.

TOMIC NEW 707 *Snap-On* All-Purpose FIXTURE CLIPS

For Use With 1½" Lathing Channel

Snap-Ons have proven invaluable for mounting boxes and hanging fixtures. Can be used in normal position, upside down or flat. Details on request.

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TOMIC ADAPTA-STUDS

No. 711A—¼" I.D. • No. 711B—⅜" I.D.

A New Simplified Way To Hang Fixtures

Only one ½" locknut required to secure box. Simplifies conversion from ¼" or ⅜" threaded rod or bolt to fixture stem.

Pat. Applied For

TOMIC #90 BOX HOLDER

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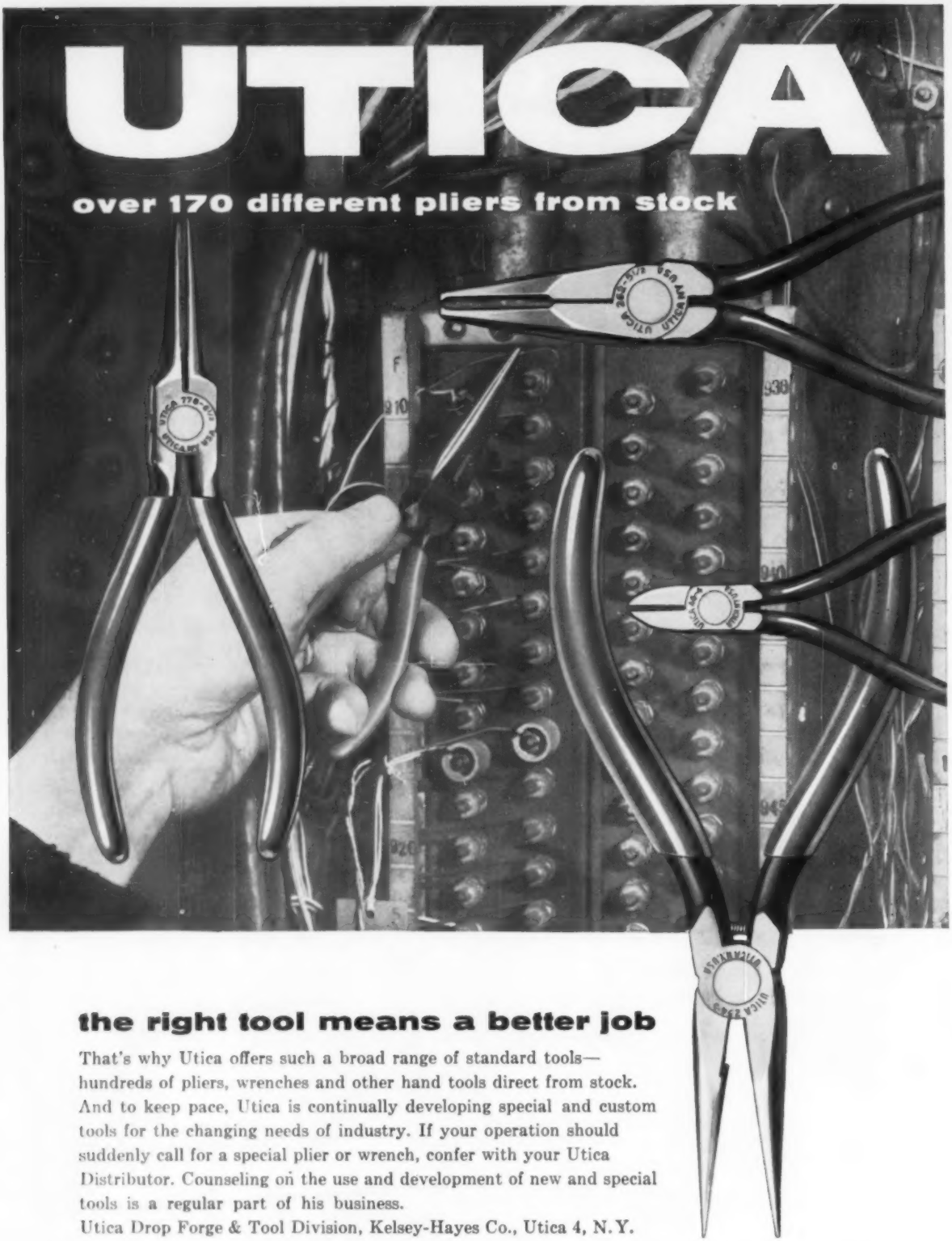

the right tool means a better job

That's why Utica offers such a broad range of standard tools—hundreds of pliers, wrenches and other hand tools direct from stock. And to keep pace, Utica is continually developing special and custom tools for the changing needs of industry. If your operation should suddenly call for a special plier or wrench, confer with your Utica Distributor. Counseling on the use and development of new and special tools is a regular part of his business.

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CATHODIC PROTECTION CABLE
Polyethylene Insulation, PVC Sheath.

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SERIES STREET LIGHTING CABLE
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TREE WIRE
Rubber Insulated, Neoprene Sheath.

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Wakefield Industrials—incandescent, fluorescent and mercury—have been tested and approved by RLM Standards Institute and now carry the RLM label,* "Your basic assurance of high quality". Write for catalog.

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EACH WAGNER CARTON
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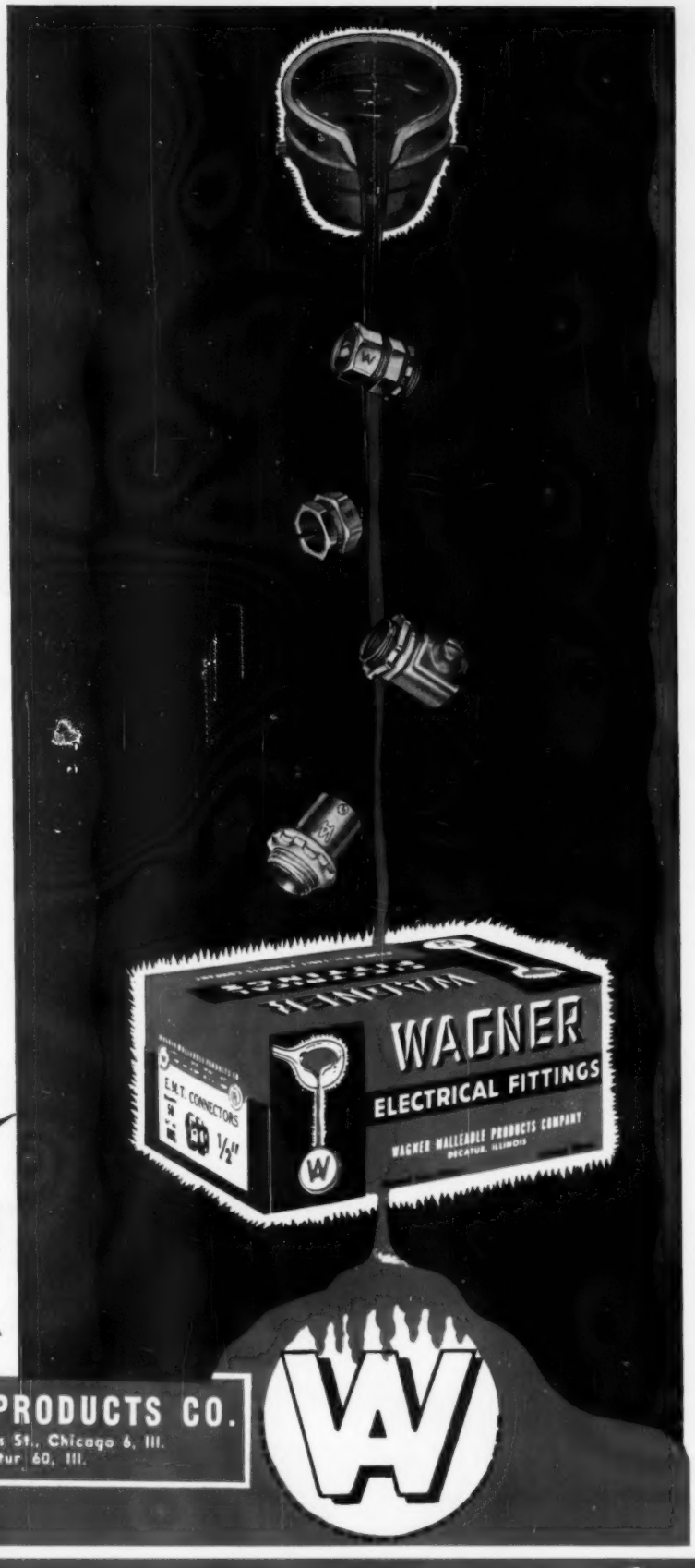

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WELLS OFFERS TWO COMPLETELY MOBILE DUAL PURPOSE, METAL CUTTING BAND SAWS

Now you can handle Horizontal Cut-off Work and Vertical Bandsawing with ONE Wells Saw

MODEL 49-A — With heavy duty, rubber tired, ball bearing wheels, and one piece fold-down handle (optional equipment), the Wells Model 49-A is a metal cutting band saw that's really mobile . . . that can be wheeled wherever needed . . . quickly . . . easily.

The 49-A is a dual purpose saw. As a horizontal cut-off machine, it has a capacity of 3½" x 6". Swing the head into vertical position . . . it becomes an upright band saw for cutting angles, slots, notches, bevels and contour work. Ample power, 3-speed V-belt drive and sturdy construction assure smooth, even cutting. You'll find the Wells Model 49-A ideally suited for shop or "job-site" work. For full details, ask for Bulletin 253-H.

MODEL 58-B — Here's the all new metal saw you've been asking for . . . designed and built to give you double duty — double value. Compact . . . rugged . . . well guarded . . . the Wells Model 58-B is an extremely versatile unit at an economical price.

As a horizontal cut-off saw, the 58-B has a capacity of 6" x 10" on rectangular shapes; 6" on rounds. It features a quick action vise (swivels to 45°), automatic shut-off and adjustable blade guides.

For vertical use, just swing the head into upright position and install the work table (optional equipment).

Other optional equipment includes a wheel-handle unit to provide complete mobility and a stock-stop assembly for repetitive cutting of identical lengths. Request Bulletin 262.

BAND SAW BLADES

Blades for Wells Model 49-A (½" x 60") and Model 58-B (½" x 93") are available in the following specifications: Raker Set—6, 10, 14, 18 and 24 teeth per inch; Wavy Set—10 and 14 teeth per inch.

STOCK STANDS

Wells Stock Stands will repay their modest original cost many times over in convenience and ease of handling long pieces of stock. Wells design assures easy action and speeds up production by reducing stock shifting time. Two models are available.

Wells saws

Wells

The Pioneers of Horizontal

METAL CUTTING BAND SAWS

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Cross Section of QUALITY

Seen in *cross section*, the Ionix Wall Convector reveals the quality and design that make it unique.

From the one-piece formed wall box to the baffled grille; from the exclusive stainless steel chimney construction to the exclusive Negative Ion Control — the Wesix Ionix Wall Convector has features found in *no other electric heater.*

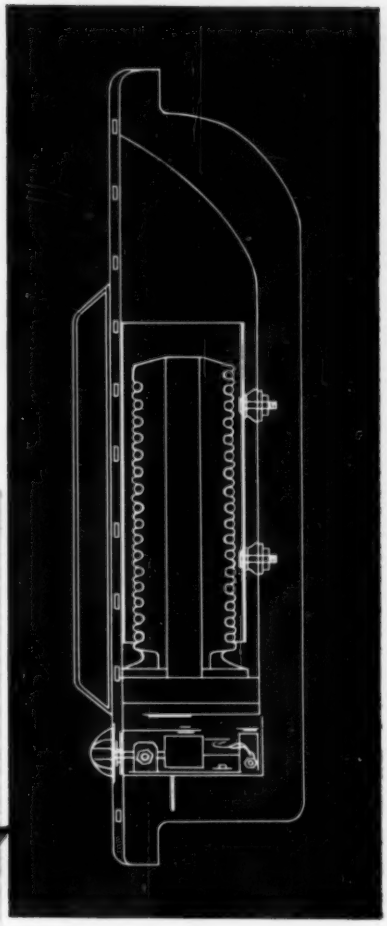
Here is a heater with low front panel temperature and a heat distribution pattern that permits almost unrestricted usage even near work or play areas or in tight places where heater placement might otherwise be a problem.

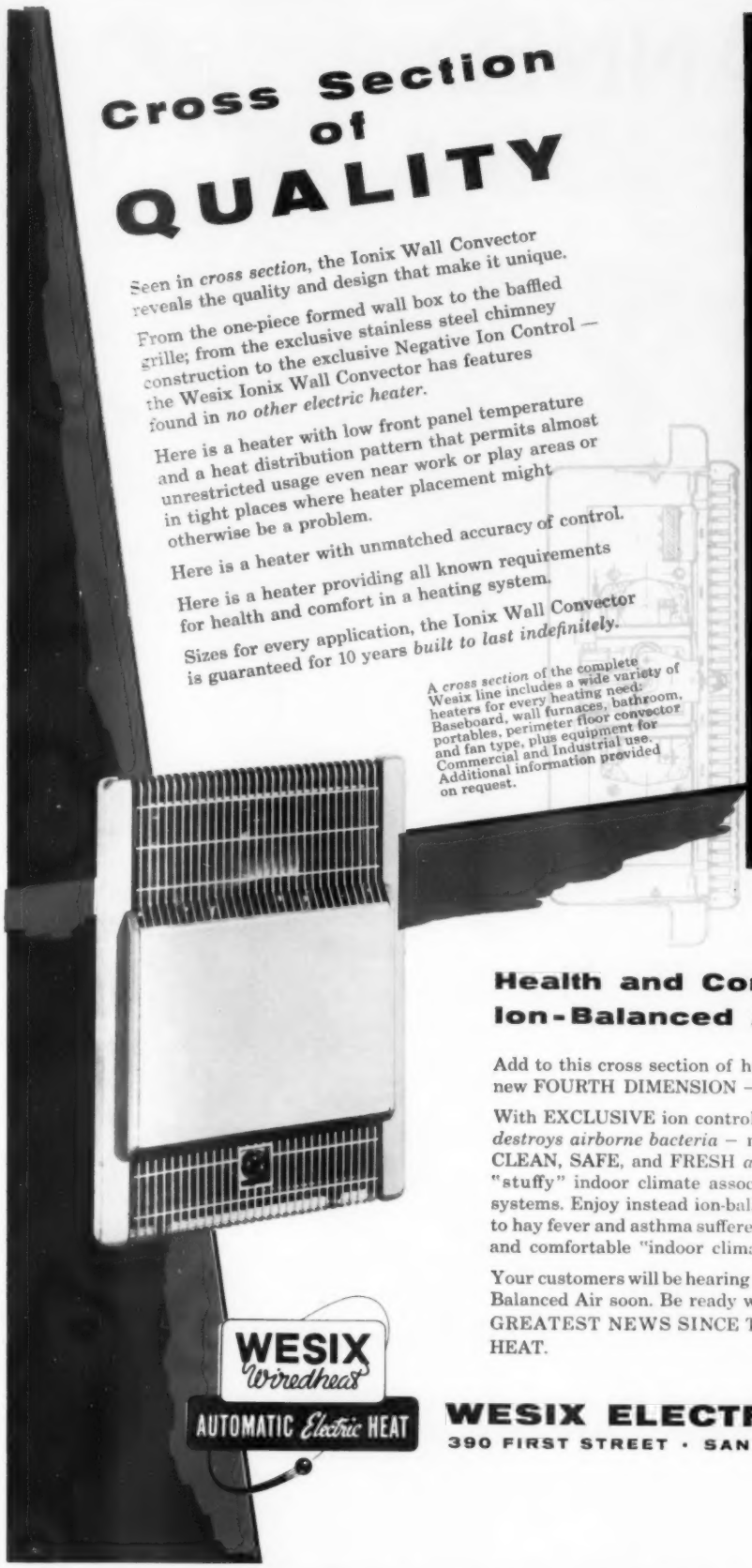
Here is a heater with unmatched accuracy of control.

Here is a heater providing all known requirements for health and comfort in a heating system.

Sizes for every application, the Ionix Wall Convector is guaranteed for 10 years *built to last indefinitely.*

A *cross section* of the complete Wesix line includes a wide variety of heaters for every heating need: Baseboard, wall furnaces, bathroom, portables, perimeter floor convector and fan type, plus equipment for Commercial and Industrial use. Additional information provided on request.





Health and Comfort from Ion-Balanced Air

Add to this cross section of heating comfort an exciting new FOURTH DIMENSION — ion control.

With EXCLUSIVE ion control, this Ionix Wall Convector *destroys airborne bacteria* — makes the air in your home CLEAN, SAFE, and FRESH *as all outdoors.* Gone is the "stuffy" indoor climate associated with old-fashioned systems. Enjoy instead ion-balanced air that brings relief to hay fever and asthma sufferers — means a more healthful and comfortable "indoor climate" for the whole family.

Your customers will be hearing more, much more, about Ion Balanced Air soon. Be ready with all the facts about THE GREATEST NEWS SINCE THE BIRTH OF ELECTRIC HEAT.

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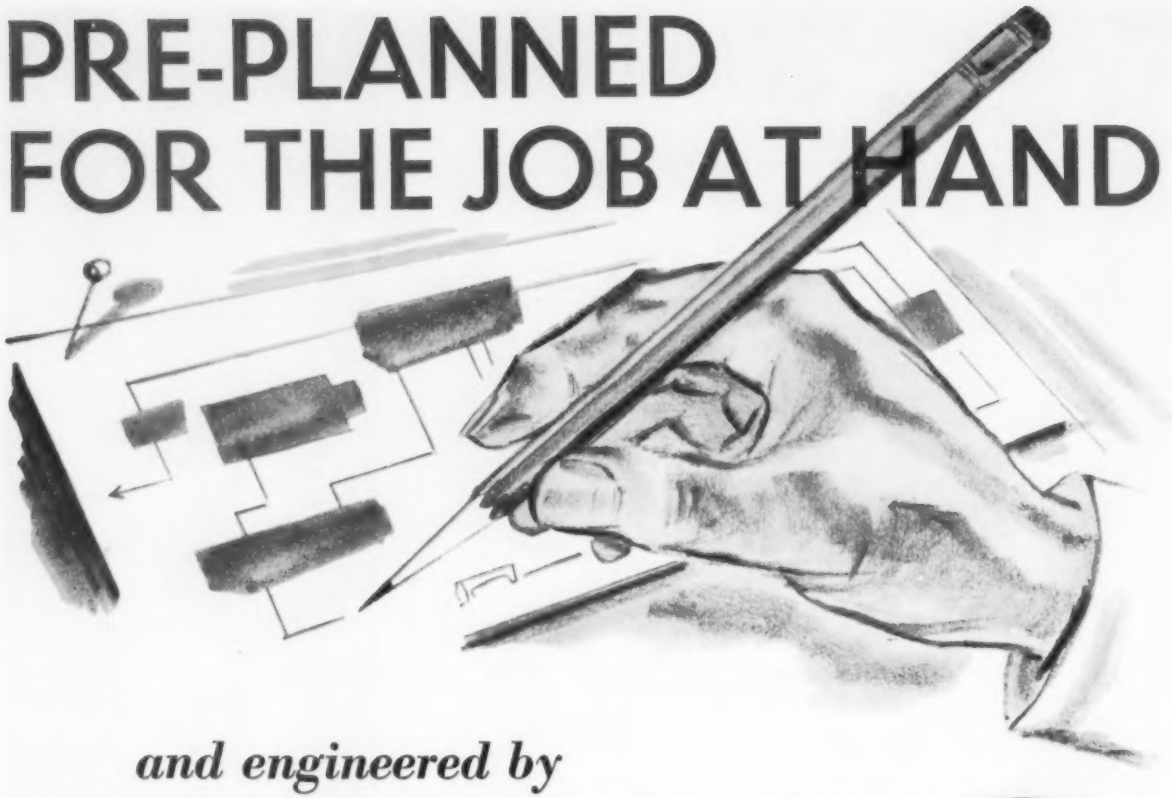

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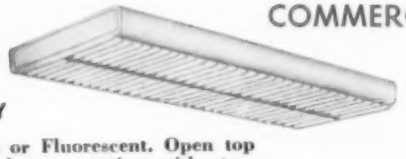

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Slimline or Fluorescent. Open top for pendent mounting with stem suspensions or surface mounting with reflector plates. Solid, or illuminated metal sides.

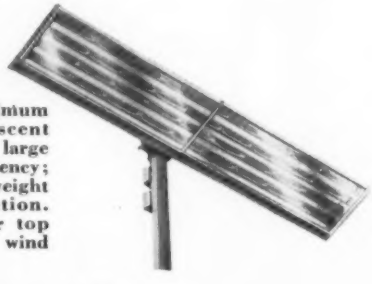
SEMI-RECESSED

An entirely new fixture, requires less than 1½" of recessed depth, plus 1⅜" for projection of the ballast. Allows installation in typical acoustic tile ceiling.

INDUSTRIAL LIGHTING

ALUMINUM DEEP BOWL UNITS

Complete line of Alzak aluminum fixtures for wide range of light distribution for medium and high bay installations. Incandescent mercury vapor lamps.



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Low initial cost, minimum maintenance fluorescent floodlight. Excellent large area illuminating efficiency; high strength, low-weight aluminum construction. Thin-line design for top appearance and low wind resistance.

From Original Design to Final Installation You Can Depend On

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Easy to order — Graybar has it

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WIDE-LITES

give you more useable light–longer

These Unique Features Make Possible Full Utilization of Greater Output of Color-Corrected Mercury Lamps!

❶ *EXCLUSIVE* RECTANGULAR DESIGN . . . complements *both* the length and the diameter of the light source. The resulting pattern is broad and unusually uniform . . . can be easily plotted to plan smooth, even coverage without concentric circles, hot spots or shadows.

❷ *EXCLUSIVE* SEGMENTED REFLECTOR with compound curvature . . . directs output from *both* the major and the minor light distribution axes of the lamp . . . may easily be replaced if damaged. Wide-Lite's *exclusive* reflector controls the unusual characteristics of the light source to create a versatile, workable pattern without sacrificing the lamp's unequalled efficiency.

❸ *EXCLUSIVE* HEAT DISSIPATING FINS . . . limit maximum lamp temperatures to most efficient operating range . . . assure retention of color-correction and long life features of the lamp.

❹ *EXCLUSIVE* THREE-WAY LAMP PROTECTION . . . assures longest-possible lamp life. Only Wide-Lites offer a rugged *cast aluminum* protective body independent of reflector, shock-resistant tempered glass lenses on *all* sealed models, and the *patented* "Stabilux Socket" to hold the lamp securely in place, virtually eliminate lamp breakage due to physical shock.

The complete line of Wide-Lite floodlights and fixtures is described in detail in new Wide-Lite Catalog No. 444. Ask your Graybar distributor for a copy or write today on your letterhead.

Manufactured by

WIDE-LITE CORPORATION WIDE-LITE.

P. O. Box 191 • Houston 1, Texas

In Canada: Wide-Lite Division of ***Wakefield Lighting, Limited,*** *London, Canada*

OUTDOOR AREA LIGHTS • VAPOR TITE MODELS • INDOOR LUMINAIRES • MOBILE WORKING LIGHTS • SPORTS LIGHTS • PROTECTIVE LIGHTS

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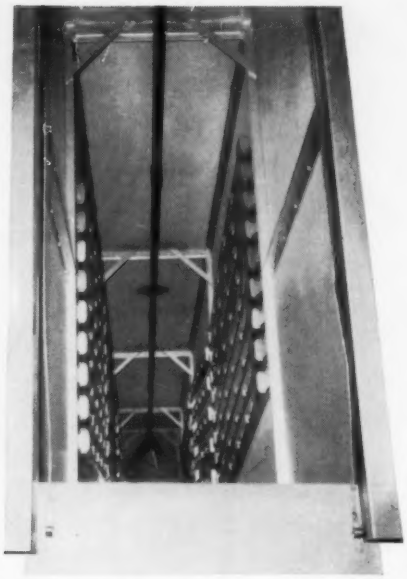
IF HEAT CAN CURE YOUR "GROWING PAINS"



From a cold start, this oven reaches operating temperatures (to 425°F) in about ten minutes. Conveyor speed is adjustable from 2 to 6 feet a minute and baking time from 5 to 16 minutes.

YOUR CHROMALOX MAN HAS THE **ANSWER**

By installing the oven shown above, a New England metalworking plant recently solved several problems arising from an expanded line of products.

Previously, some of the company's products had been sent out for painting and baking, while the remainder were painted and air dried at the plant. When a new, larger item was added to the product line, neither the company nor the outside firm was equipped to handle the paint baking. After considering the outside charges and delays which had caused them to lose some rush orders, it was decided to install their own oven. They then called in the Chromalox Man for a quick, economical, electrical answer.* Now, all painting and baking is done at home in a 32-foot electric radiant oven, using 42 Chromalox Type RAD Far-Infrared Heaters.

Chromalox Input Controllers accurately regulate baking temperatures for each of the three heat zones. With these cycling devices, capacity can be accurately controlled from 4 to 100% of heater capacity. Top or bottom sections of each zone can be shut off to handle varying work sizes.

Chances are your Chromalox Man can help you find answers to *your* production line heating problems.

**For a detailed account of this actual case history, write for Application Report 403.*

4982

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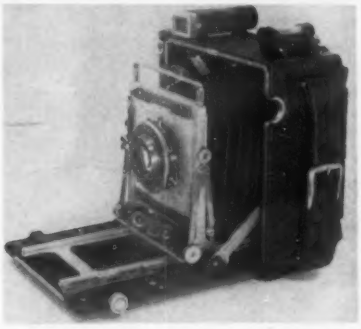
Photographic Record Of Conduit in Slabs

METHOD

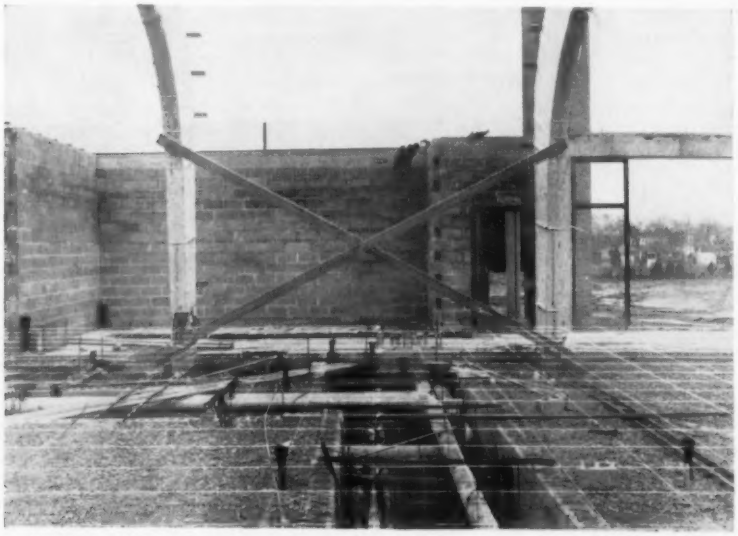
Every building owner is someday faced with the problem of new occupancy, a change in arrangement or some alteration which requires locating the appurtenances that go with a building. But plans of existing buildings are not reliable for locating accurate positions of vital elements concealed in the floors. As a result, very large areas of floor frequently have to be torn up when "prospecting" for junction boxes, conduits and other buried equipment. To keep the tearing up of sound floor and walls to a minimum, Photo Perspective Corp., St. Louis, Mo., has developed a photographic method for permanently recording exact locations of equipment in floors.



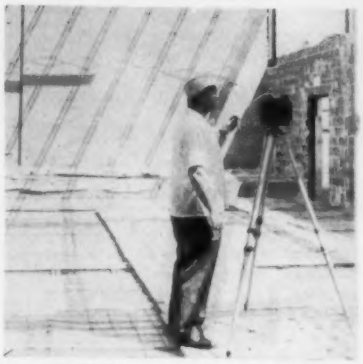
PRESS CAMERA for use in the method is purchased through Photo Perspective, who equip it with a spirit level on top of the case, then make a master grid for the camera-lens-level combination.

The new method consists of taking special photos of the floor contents before the concrete is poured. A specially adapted camera is set up to take a picture on which a calibrated grid is later superimposed. This grid is marked in feet and provides ready correlation between points on the grid and equipment buried in the floor. For the life of the building, then, this permanent record can be used to establish coordinates on the finished floor for any equipment shown in the original photo. The method applies the principles of aerial surveying to building construction, providing a valuable record for use by building management in any modification or modernization of the building.

Photo Perspective Corp. sells the cameras used in this method at factory list price plus guarantee. They recommend a 4 by 5 Pacemaker Speed Graphic or Crown Graphic with either a 127 mm or 135 mm lens. These cameras are purchased by P-P Corp, upon request. First an accurate spirit level is attached to the top of the case. Next a master grid is made for each camera, lens and level combination. It takes two weeks to make the master grid, but there is no charge for this. Then the camera is mailed to the customer.



FINISHED PHOTO for each area shows the layout of equipment before concrete is poured—with the pre-calibrated grid superimposed on the area, to show distances marked in feet in the plane of the top of the finished concrete.



ON THE JOB, camera is carefully set up to photograph floor areas and their contents before concrete is poured.

The method itself is as simple as setting up a level and taking a photo. Each 20- by 20-ft or 20- by 40-ft area of floor which has sufficient equipment in it is photographed just prior to the concrete pour. The camera is set up 20 ft back from the desired 0 line on the finished floor. It must be mounted at a carefully determined height of 5 ft above the level to which the poured floor is finished. The spirit level on the camera is used to adjust the camera to a level position. Columns are then marked, and a slate is properly inscribed to identify the bay and placed to appear in the photo. Designations made to show up in the picture should correspond to blueprint references.

The 4 by 5 developed negatives are then sent to Photo Perspective Corp. where they are printed on Resisto Rapid (for $3.50 per 11- by 14-in. photo) with the superimposed grid and returned to the sender. The photos are then filed by the building management until needed.

The 4 by 5 Pacemaker Speed Graphic has a Graflock back, Ektalite screen, Kalart rangefinder, 135-mm f4.7 lens with X sync. The Pacemaker Crown is the same except that it has no focal plane shutter. Prices of cameras range from $238.00 to $370.00, subject to factory change.

This method of recording locations of hidden equipment can be used by plant electrical departments or by contractors and engineers as part of their service.

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"Packaged" Installation Of Heated Driveways

ELECTRIC HEATING

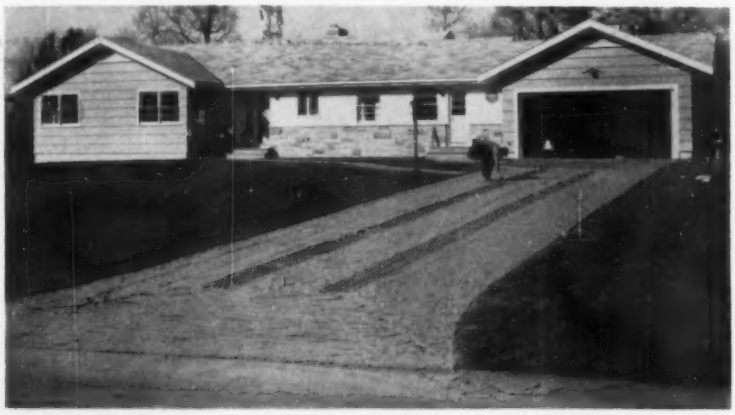
A new service for home-owners who want to get rid of the troublesome task of shoveling snow from their driveways or sidewalks, has just been announced by the Silliman Company, one of the largest and oldest paving-contractor firms in the Bridgeport, Conn., area. The company, noting an increase in interest among home-owners and builders for electrically heated driveways, now offers its customers a choice of either asphalt or concrete driveways or sidewalks complete with a heating cable system for snow melting.

Although heating cable has been widely used for snow melting for many years, the combination of paving and electric heating from a single source is believed to be the first "packaged" service of its kind in the country. The first such installation has just been completed by the Silliman Company for a new home in Trumbull, Conn. The owner of the home, learning of Silliman's new plan, was quick to decide that since his home was all-electric, it would be practical and economical to let electricity do the work of snow melting in his long, 90-ft driveway.

Frank Adriani, president of the firm, explained in announcing the plan that this "packaged" heated driveway simplifies the installation for the home-owner since the Silliman Company does the complete job from start to finish, using General Electric heating cable and the services of a licensed, experienced electrical contracting firm for calculating the heating requirements and doing all of the electrical work.

CABLE LAYOUT on sandy base of driveway was facilitated by the use of a board with nails set to keep proper center-to-center spacing between cable lengths. Board was removed as soon as each circuit was laid out and then used for the next circuit. Because of the stiffness of its lead sheath, the cable holds its shape and remains in place on the ground.

HOME RUNS for heating cable circuits were made with type UF Fiamenol underground cable. Usual practice was to connect two lengths of heating cable to each UF home run in a box, as shown. The system is completely grounded.



RESISTANCE CHECK was made on the finished layout of cable by means of a Megger. Note cable is laid out for entire width of the driveway apron, for a depth of a few feet across the entire width of the garage and only for the width of wheel paths between the two ends of the driveway.

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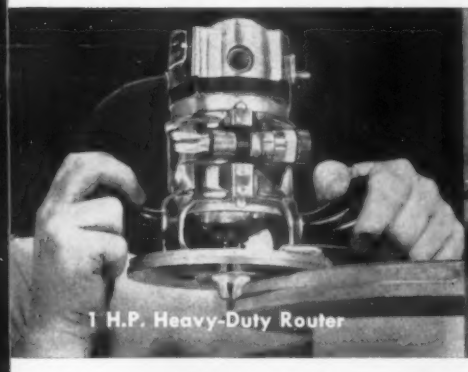
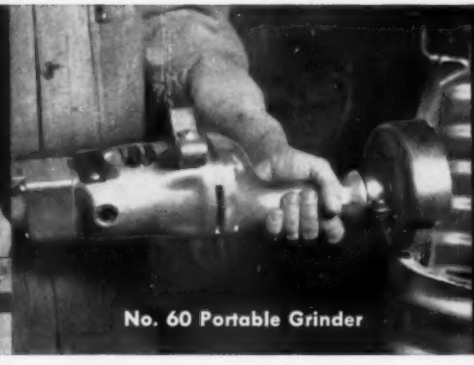

1 H.P. Heavy-Duty Router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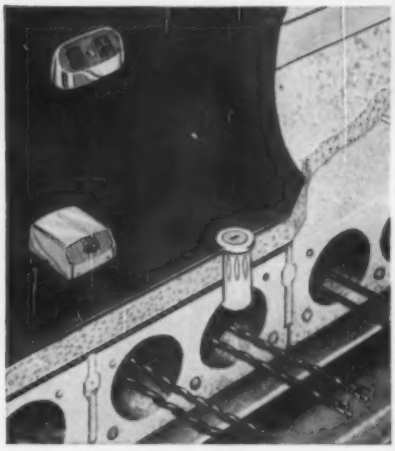

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BLACK TOP covering was dumped from asphalt truck which backed into driveway with its wheels clearing the heating cable without difficulty. At apron end of driveway, where cable was laid full width, it was moved aside to let the truck in. The rigidity of the cable itself permits moving the cable without changing its form of layout. White cables shown are type UF home runs.

FINISHING TOUCHES are applied by paving mechanics who rake asphalt over apron end of driveway. Apron cable layout was replaced after truck left the driveway. Entire driveway is rolled to compact it.

Mr. Adriani also reports that even before formal announcement, this new service has created considerable interest, not only for those who require surfacing of residential driveways, but for various commercial uses as well.

Actual experience has proved that the heating cable installation takes only a matter of a few hours and does not slow up the laying of the black top or concrete which is dumped and spread directly over the cable as it lies on the ground. Accompanying photos show various steps in the job, from beginning to end.

Solar Research House Shows Promising Future

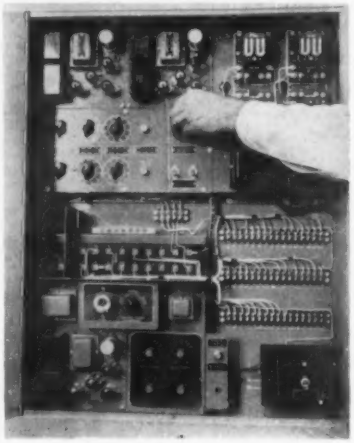
SOLAR-HEAT PUMP SYSTEM

A new concept in residential heating and cooling, using a copper roof to collect heat from the sun to warm the house in winter and utilizing the same roof to reject heat for summer cooling, is being tested with considerable success at the University of Arizona in Tucson.

Constructed by the Institute of Atmospheric Physics, the test house represents a typical 3-bedroom ranch-type home in the $16-18,000 price range capable of being heated with significant savings in over 50% of the geographical United States. Water circulated through the conductive copper roof collector is heated by the sun, stored in a large insulated tank outside the house, and recirculated through copper ceiling panels inside the house. During protracted cloudy weather, or when the outside air temperature drops below a given point, a supplementary heat pump system using a 1½-hp compressor motor goes into action to heat the water. When the cloudy period or cold spell passes, the roof collector brings the entire tank back to the required temperature and the heat pump automatically shuts off.

For summer cooling, the copper roof collector rejects heat from the system each night by radiation and convection to the atmosphere. During extremely hot weather, the heat pump withdraws heat from the warmer water at the top of the tank and returns the cooled water to the bottom.

Components of the custom-built instrumentation used to control the system include electronic amplifiers as primary relays, special limit controls, a heating or cooling selector switch, and an electronic room thermostat. Much of this equipment is for test purposes, and simplified controls will provide com-



ELECTRONIC CONTROL system of solar research home includes much instrumentation used solely for test purposes. Actual residential system would use simplified controls for automatic operation.

Newly designed
Type H Motor Control

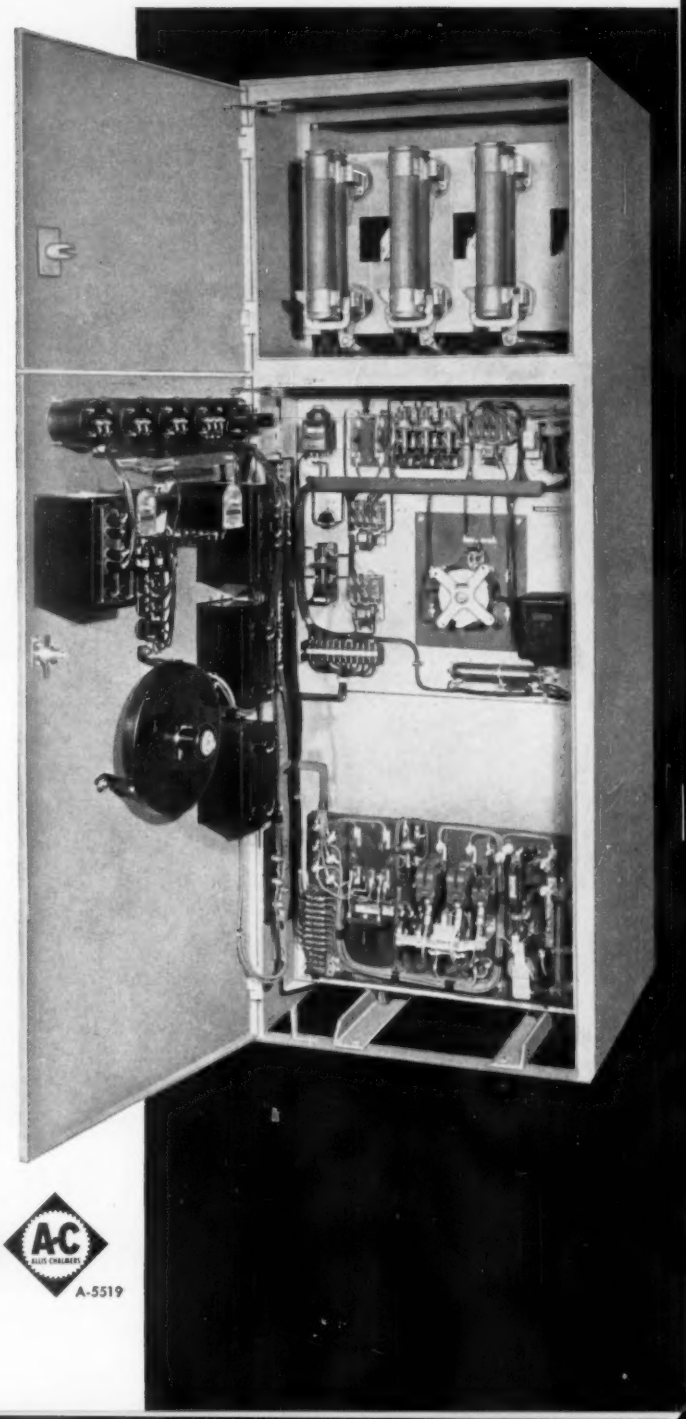
More room for optional features

Now, with Allis-Chalmers high voltage control, you get more panel space for additional components.

Meters, pushbuttons, instruments, rheostats, indicating lights, relays, and other components can be installed—thanks to the ample space available on both the outer door and inner barrier.

Along with more room, this new A-C design is front accessible, has smaller cabinet size, provides ultimate in protection for men and machines, and has been completely tested.

For more information on this engineering advance, contact your A-C office or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

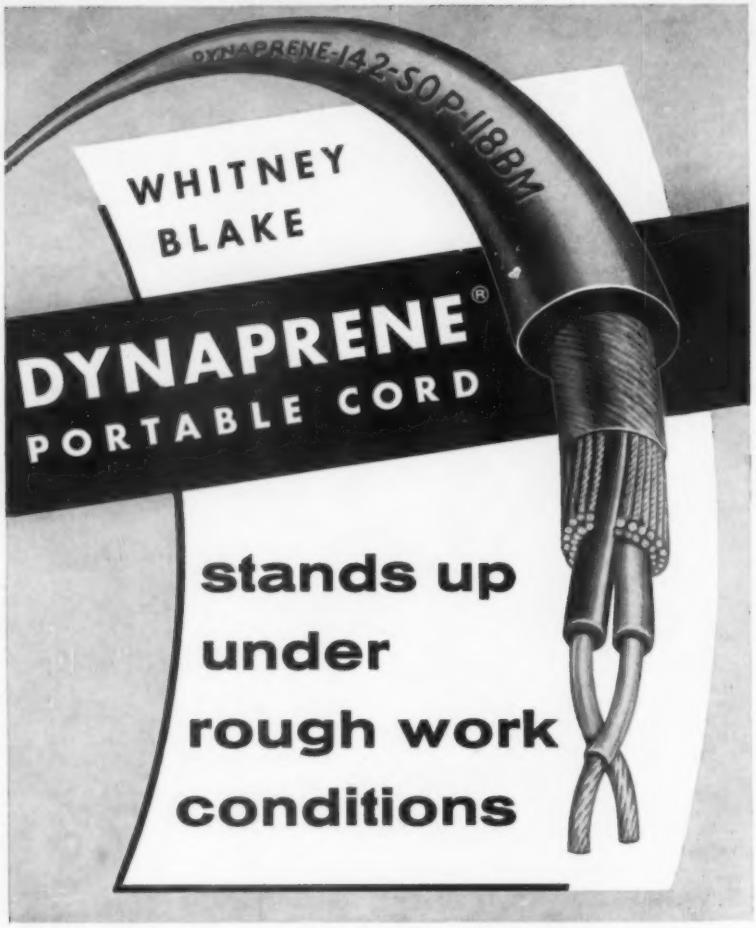


All this area on Allis-Chalmers new Type H motor control is available for optional features. In many applications, this extra space eliminates the need for an extra cabinet.

Removable panel, on which control devices are assembled, is mounted on inner barrier. Entire panel may be quickly removed for inspection and maintenance.

ALLIS-CHALMERS

A-5519



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pletely automatic operation in an actual residential installation.

The combination solar-heat pump system is expected to heat and cool the experimental house at a maximum cost of $200 per year—half the cost of a conventional system.

Its developers believe it to be so close to economic practicality that they predict commercially sound solar heating and cooling systems within the next five years.

Band Saw Speeds Luminous Ceiling Installation

TOOLS

Metal cutting band saws are finding increased acceptance in the electrical construction field. Power cutting is replacing hand methods on almost every job where a substantial number of cuts have to be made. Kelso-Burnett Electric Company of Chicago long ago began operating on this premise. As a result, some form of power-driven metal saws are found on almost all of their jobs.

Convincing proof of this is evident at a recent bank relighting job where plans called for installation of a complete luminous plastic ceiling over the entire main floor area of the bank. Here, Kelso-Burnett's mechanics used a small portable type band saw to make all cuts necessary for proper installation of the ceiling's steel channel grid and the aluminum T-bar framework. Not only did the band saw make quick work of all cutting operations, which saved a considerable

PORTABLE BAND SAW used on luminous ceiling project reduced installation costs by taking the drudgery out of hand-cuts, reducing workers' fatigue, and by increasing overall efficiency with its exacting straight cuts. Workman is shown here cutting a bundle of ½-in. steel tube into exacting 2-ft lengths which will be used to carry circuits between each row of fixtures.

amount of time and cut labor costs; it also increased overall efficiency by its exacting straight cuts.

Generally, the type and size of a band saw to be used on a project is determined by the various job factors. For example in this particular case, it was found that by using a small (easily portable type) saw as shown in the accompanying photo, the drudgery of "lugging" work to a central location was eliminated by simply moving the lightweight saw to the actual points of installation.

Large Area Lighting For Lecture Room

LIGHTING

A new "Large Element" fluorescent lighting installation today provides high-level, uniform illumination in the lecture room of Philbrick Researches Inc., Boston, Mass. And maximum comfort is provided by the low brightness of the ceiling-area layout.

In this installation, the uniform level is approximately 115 maintained footcandles. The large modules which make up the translighted ceiling are attractive as well as functional. They can be used separately but are here assembled to create a lighting system which provides the effect, low cost and utility of dropped ceiling construction. The module elements are 2 ft by 2 ft in size and may be used in multiple to create any area arrangement.

The actual light is produced by slimline fluorescent lamps in each "Large Element" unit, which is assembled and wired at the factory. The shielding media consists of plastic cellular louver panels, with 45° by 45° shielding. The luminaires used here were made by Smithcraft Lighting.

NEW IDEAL SIMPLET
PULLING ELBOWS and ADAPTERS
· MALLEABLE IRON · PERFECT 90° FIT

PNF PULLING ELBOW
Two female threaded hubs at precise 90° angle. Rigid, domed covers with full neoprene gaskets. Sizes ½" to 2".

PNH PULLING ADAPTER
Two hubs at perfect 90° angle, one female and one male threaded. Rigid, domed covers with full neoprene gaskets. Lock nut included. Sizes ½" to 2".

Make Wiring Around Corners a SNAP!

QUICK, EASY-TO-USE

Pull wires straight thru conduit and one side of elbow.

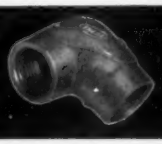
Make big loop of wires and pull thru other side of elbow and conduit. No obstructions inside elbow—gives smooth travel.

Pull wires taut from other end of system — cover attaches quickly with big screws, opens easily anytime.

MADE BETTER FOR YOUR NEEDS

- malleable iron, cadmium plated, chromate treated
- steel cover cadmium plated and chromate treated with larger screws designed to fit snugly in opposed corners without protruding inside
- cover domed for greater rigidity, provides more working space and more wire area inside
- full neoprene cover gasket (not cut out)
- milled surfaces assure tighter seal
- more metal at inside radius provides more strength, durability
- no obstructions inside, all smooth surfaces, tapped holes recessed
- precision tapered pipe threads positioned exactly 90° center to center in the same plane
- sold complete with covers, screws and gaskets — shipped assembled
- sizes marked on both covers and elbows

"L" TYPE PULLING ELBOW ALSO AVAILABLE
Malleable iron body has two female threaded hubs, at 90° angle. No-thread type also available. Swing style, steel cover attached to body. Angular opening permits straight pull of wires. Gaskets available at extra cost. Sizes ½" to 1".



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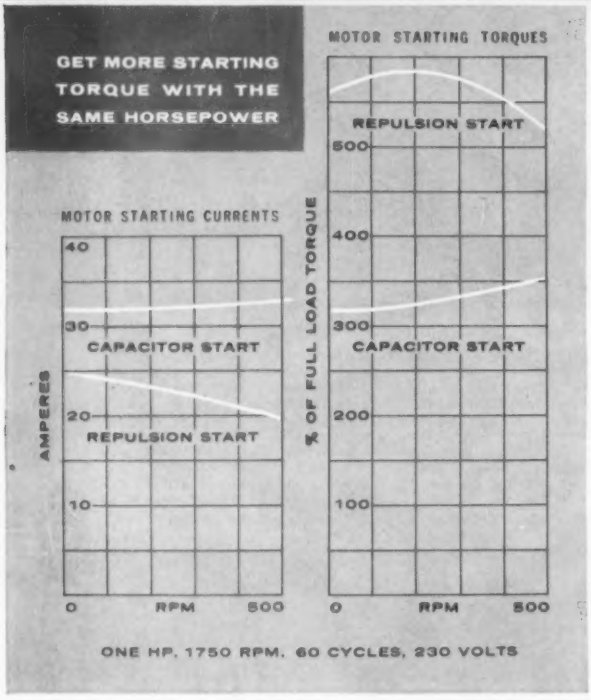
TOUGH STARTS MADE EASY...

WAGNER REPULSION-START INDUCTION MOTORS



START HEAVY LOADS WITH EASE

STAND UP UNDER LONG SERVICE

USE EXTREMELY LOW STARTING CURRENT

Starting heavy loads is a natural for Wagner Type RA Motors. Widely used for high starting torque applications, like farm machinery, compressors, pumps and grinders, this rugged single phase motor requires very low starting current that minimizes light flicker. You get smooth performance with a constant high operating speed, even under overload, and a flat efficiency curve over a wide operating range.

You practically eliminate service problems when you power tough single phase applications with these motors. They have unmatched ability to start high inertia or heavy friction loads repeatedly and they give many years of unfailing service.

You can get these motors from leading motor distributors in your community or through Wagner Sales Offices in 32 principal cities. Your Wagner Sales Engineer will be glad to help you select the right motor for your application. Wagner Bulletin MU-220 gives full details on Repulsion-Start-Induction Motors.

WM59-8

Wagner Electric Corporation

6413 PLYMOUTH AVENUE, ST. LOUIS 14, MISSOURI

SERVING 2 GREAT GROWTH INDUSTRIES... *ELECTRICAL... AUTOMOTIVE*

SMALL WIRE-AND-FIBER drum-rig is placed just above rewound stator, motor leads are connected and power is switched on. If rotation of drum coincides with desired rotation of rotor, unit is assembled and leads are permanently established.

"Bird Cage" Checks Direction of Motor Rotation

A simple method for checking the rotation direction of a newly wound motor is used in the Wesley Jagger shop in Wilmington, Del. The testing device, having the appearance of a bird cage, consists of fiber discs at top and bottom, a $\frac{3}{8}$-in. spindle and 11 turns of No. 10 wire.

When stator leads are connected and the cage is lowered to a point just above the ends of stator coils, the test wheel will start spinning. If the direction of rotation is contrary to what it should be, the leads are reversed.

This practical precaution eliminates doubt when completing the connection job. It also eliminates the possibility of having to tear down a finished job to reverse leads after the unit has been sealed.

Sturdy Growler Stand Adjusts to Rotor Size

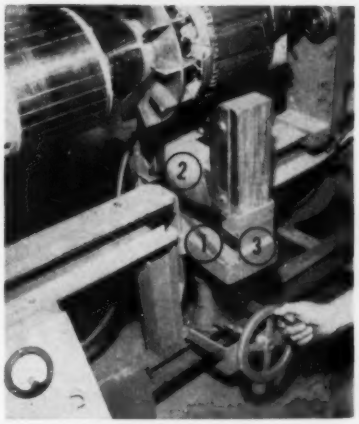
Practically any size armature can be given the conventional growler test with comparative ease in the repair department of Marion Electric Motor Service, Inc., Marion, Ohio. A recent addition to the electrical equipment test facilities is an adjustable armature stand incorporating a large growler which can be raised or lowered to accommodate various rotor diameters.

Designed and built specifically for shop use by shop foreman R. L. Patrick and his mechanics, the unit features a 26-in. lateral adjustment for each of the ball-bearing saddles supporting the rotor shaft and a 10-in. vertical adjustment of the jack-actuated growler. A foot switch, magnetic contactor and ammeter completes the test circuit equipment.

Two sturdy cast A-frames about 45 ins. apart support the rotor stand. A 3-in. I-beam, joining the A-frame midpoints near the base, forms the basic support for the growler screw-jack and its hand wheel. Tops of the A-frames support a 66-in. length of 4-in. by 4-in. I-beam along which the rotor shaft saddles slide. A 6-in. wide section cut out of the center of this beam provides a well for the growler. Two-3-in. I-beam uprights between the lower and upper beams add rigidity to the frame, form the sides of the growler well, and have inner "guide rails" to maintain growler alignment during and after vertical adjustment.

U-shaped growler is 14 ins. long, 10 ins. high and has a stack of laminations $3\frac{5}{8}$ ins. thick. Two end brackets seat the growler in vertical position and have a "parallel-blade" base clamp which fits over

ADJUSTABLE GROWLER and rotor stand with "quick-set" features was developed by shop superintendent R. L. Patrick, shown here making a growler test on a large armature.



GROWLER IS RAISED or lowered by turning hand-wheel on screw jack. Supporting tray (1) rides guide rails (arrow) to maintain position and alignment. Growler unit (2) is seated in end clamps (3) which fit over side of tray.

the sides (ends) of a steel supporting tray fastened to the top of a screw jack. The long sides of this tray have slides which ride the inner guiderails of the growler well. In addition to supporting the growler, this metal tray provides a handy repository for the metal "feelers" used in conjunction with the test. Bottom of the growler unit rests about 6 ins. above the bottom of the tray.

All electrical connections (service cord, growler and foot switch) are made with heavy-duty, rubber-jacketed, flexible cord. Control is centered in a magnetic contactor cabinet-mounted on the side of the A-frame. A flush-type ammeter (0-50 amp range) in the hinged cover gives the operator a visual indication of the test results.

The adjustable shaft supports are 12-in. lengths of 6-in. by 2-in. steel channel welded to a grooved block which slides on the I-beam flange. A threaded bolt with a T-shaped hand grip locks the sliding block in any desired position along the beam. A shallow-V cut in the top of the channel provides clearance for armature shaft extensions seated in a frictionless saddle provided by two $3\frac{1}{2}$-in. diameter ball bearings rotating on bolts welded to the channel upright.

Only three adjustments are needed for any size rotor: the two saddles and growler. Normally the growler is kept in retracted or down position. The armature is

Shuford's NEW ELECTRICAL TAPE

SHURTAPE® EV-57

A VINYL PRESSURE-SENSITIVE TAPE FOR HIGH VOLTAGE INSULATION

Here's a vinyl tape which combines desirable electrical characteristics with high resistance to oils, corrosive chemicals, humidity, fungus and mildew . . . conforms to irregular surfaces . . . works easily in limited areas.

Use it . . . to protect splices and connectors in power control leads. **Use it** . . . to insulate high voltage motor leads. **Use it** . . . on bus bars . . . as pipe wrap . . . to insulate wires and splices in junction boxes and TV-Radio installations.

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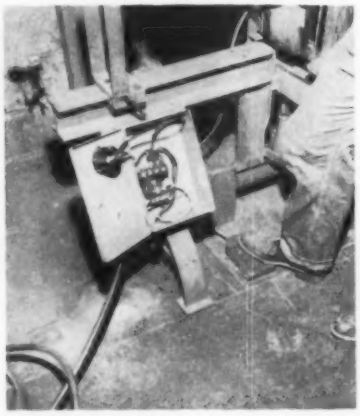
SHAFT SUPPORTS consist of ball-bearing saddle (A) on steel channel upright (B) with grooved base which slides on I-beam (C). Each support has 26-in. lateral adjustment, is securely "locked" in position by tightening hand-bolt in base.



CONTROL CABINET on side of stand houses magnetic contactor for foot-switch at right and ammeter in cover. With cover closed, meter can be seen by operator.

brought to the stand with an overhead hoist and lowered into position after the saddles have been adjusted for shaft length. The growler is then raised to proper height by turning a hand-wheel which operates the screw jack. Reversing hand-wheel direction will lower the growler.

Exhaust Drum Keeps Shop Area Dust-Free

A simple, inexpensive exhaust system at the Wagner Electric Company motor repair shop in Ft. Wayne, Ind., keeps the stator stripping and cleaning area free of dirt and dust when blowing out motors or stators with a compressed air stream. Instead of the conventional exhaust hood over the work space, owner G. I. Wagner prefers a forced down-draft to pull the dust away from the work and the mechanic's eyes.

To accomplish this, Wagner mechanics devised an "exhaust drum" using a discarded 50-gallon oil drum measuring 23 ins. in diameter and 34 ins. high. About 18 ins. above floor level, an 8-in. diameter exhaust pipe leaves the back of the drum and goes through a wall to a ½-hp, 3450-rpm, 110-volt centrifugal blower (stoker type). A duct extension from the blower carries the exhaust outdoors.

Motors to be cleaned are placed on an expanded-metal "cover" welded to a square angle-iron frame which fits over the open top of the drum. A handy foot switch permits the mechanic to turn the blower on or off as desired. The down-draft created by the blower and pipe extension inside the drum pulls the dust downward to the base of the drum and out through the

EXHAUST DRUM creates forced down-draft which pulls dust and dirt into barrel and away from mechanic's face and eyes. No overhead hood and ducts are needed.

DUCT CONNECTION to exhaust blower extends inside drum about 18 ins. above floor. Top of duct is longer than bottom. Resultant down-draft exhausts dust, lets heavy particles settle in drum.

Accent on Excellence

Youngstown "Buckeye" steel conduit

This highly-functional modernistic department store building—only one of many new structures that will make up Denver's Zeckendorf Plaza Development—has built-in lifetime wiring protection, thanks to Youngstown "Buckeye" Full Weight Rigid Steel Conduit.

Damaging elements such as water, moisture, vapor, dust and dirt can never cause disruption of the building's all-important electrical system, because "Buckeye" Conduit will perform its protective function as long as the structure remains standing.

Installation of Youngstown "Buckeye" Conduit is shown during construction of the new May-D&F Department Store in Denver, Colorado.

Zeckendorf Plaza Development,
Denver, Colorado
OWNER: *Webb & Knapp, Inc., Denver, Colorado.*
ARCHITECT: *I. M. Pei & Associates, 385 Madison Ave., New York, N. Y.*
GENERAL CONTRACTORS: *Webb & Knapp Construction Corp., New York, N. Y.*
ELECTRICAL CONTRACTORS: *Fischbach and Moore Incorporated, B412 Mile High Center, Denver, Colorado.*
CONDUIT SUPPLIER: *The Mine & Smelter Supply Co., 3800 Race Street, Denver, Colorado.*

When you specify "Buckeye" Conduit, the high standards of Youngstown *quality*, the personal touch in Youngstown *service* will help you create electrical wiring systems with an "accent on excellence".

Carefully selected Continuous Weld pipe

is first accurately threaded. Next, the pipe is thoroughly cleaned by pickling. Then it is immersed in a bath of molten pure zinc. A special process is used to remove it from this bath so that a clean, smooth zinc coating remains on both inside and outside. Then a coating of tough, transparent lacquer is baked on both inside and outside surfaces, providing a smooth raceway through which wires may be easily fished. This is Youngstown's long-lasting, trouble-free, easy-bending hot galvanized Buckeye Conduit.

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SHEET AND TUBE COMPANY
Manufacturers of Carbon, Alloy and Yoloy Steel
Youngstown, Ohio

Whether it's tool belts or safety straps . . . pliers or wrenches . . . grips or climbers, linemen and electricians know they can expect the highest in quality when their equipment carries the name Klein.

For more than a century Klein has been the leader in designing and producing tools and equipment to serve the exacting needs of the utility field.

Today, wherever power lines or communication lines are strung, Klein tools and equipment are in greater demand than ever, assuring safer, speedier line construction and operation.

WRITE FOR FREE TOOL GUIDE
A free copy of the new Klein Pocket Tool Guide will be sent on request.

ASK YOUR SUPPLIER
Foreign Distributor: International Standard Electric Corp., New York

Mathias KLEIN & Sons
7200 McCORMICK ROAD • CHICAGO 45, ILLINOIS

CENTRIFUGAL BLOWER behind partition pulls air stream down through drum and exhausts it through duct line to outdoors. Motor is ½ hp, 3450 rpm, 110 volts, single-phase.

exhaust duct. Heavy dirt particles settle on the bottom.

Wagner mechanics like this system which pulls the dirt and dust down and away from their face and eyes and confines it inside the drum. They even use it when grinding and polishing metal parts on a pedestal grinder which can be swung into position over the drum. When necessary, the grid cover can be lifted off, the drum pulled out from the wall and tipped for cleaning.

Pay-Out Drum for Magnet Wire Pails

A number of motor repair shops are now buying magnet wire, sizes No. 24 through No. 15, in 100-lb "pails" instead of conventional reels. Wire in pails comes coiled around a large-diameter cardboard tube and unwinds between tube and side of pail during payout to the winding head. Some shops use payout devices available for pails; others make their own.

A Des Moines, Ia., repair shop, using wire pails rather extensively in its winding department, designed a simple inverted-funnel payout drum to keep the wire from kinking and snagging during the coil winding operation. The drum cylinder is a 10-in. length of 11-in. diameter sheet metal furnace pipe which telescopes snugly into the top of the wire pail. Centered in the drum is an inverted funnel supported by sheet metal rings about 2½ ins. from the top and 3½ ins. from the bottom of the cylinder. The funnel cone tapers from a 7⅞-in. dia. at the mouth to about 1 in. at the base of the tube extension. Top of the tube is ⅞ in. dia. and flush with side of the cylinder. Both ends of the funnel tube are lined with the inner race of a ball bearing to provide a smooth hard-wearing surface for the wire to pass over as it goes to the winding head.

Some of the wire pail cardboard tubes are slightly longer than others. To accommodate this variation, three spacer bolts are added to the payout drum about 1 in. from the bottom of the cylinder. These bolts rest on the pail rim and maintain the necessary clearance between funnel and pail tube for smooth wire payout.

With the wire pails and payout drums, mechanics in this shop have been able to increase coil winding speed about 50%. On some jobs, winding head speeds of 1200 rpm have been used to gain a substantial time advantage on fractional horsepower work.

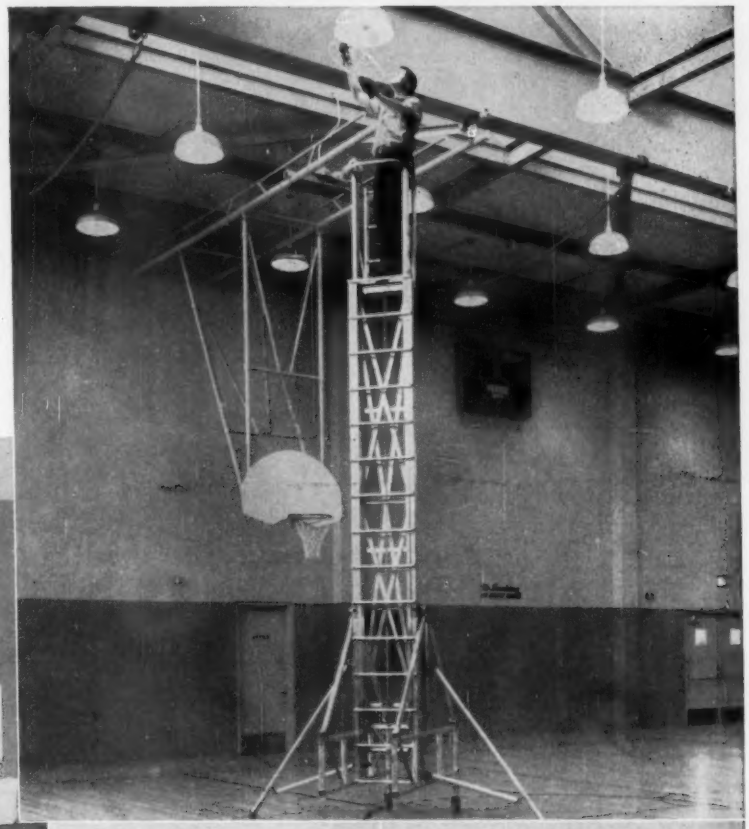
PAY-OUT DRUM telescopes into top of magnet wire pail. Tip of inverted funnel is flush with top of drum. Weight of wire and pail prevents tipping during payout.

BOTTOMS UP view of payout drum showing wide mouth of funnel, which guides unwinding magnet wire through funnel throat to coil form.

UP-RIGHT ANNOUNCES

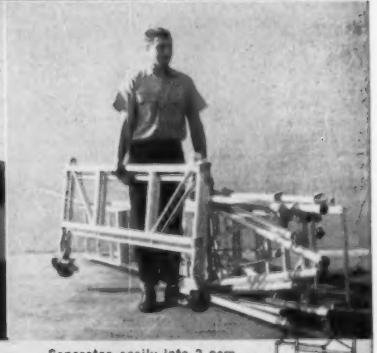
TALLESCOPE ...telescoping aluminum work platform for overhead construction and spot maintenance

Lightweight, rapidly assembled by one man. Extends instantly for reaching heights up to 30 ft. Telescopes for rolling under trusses and other obstacles. Adjustable legs for uneven floors or stairways.



Rolls through doorways . . . only 29" wide, telescopes and folds down.

Bridges over auditorium seats.



Separates easily into 3 components for convenient storage or transportation.

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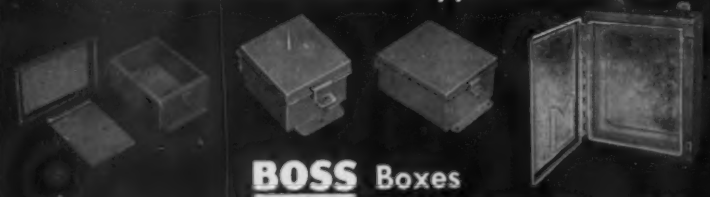

BOSS Boxes

Smooth corners . . . all sizes from 4½" x 5" to as large as needed. Surface or flush mount, with hinged or screw-on covers.

"The Line of Least Resistance"

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BOXES AND WIREWAY

Be sure of QUALITY, positive of excellent SERVICE on stock or "specials", with the complete line of BOSS Boxes, Wireway & Fittings. UL approved.

BOSS Flangeless Hinged Cover Lay-in

Assemble and lay in wire after wireway is installed—no wire pulling or risk of damaging insulation!

BOSS Flanged Hinged Cover

Flanged on both ends . . . any number of sections can be put together. Knockouts on sides and back.

BOSS Flangeless Screw Cover

Equipped with protective screw shields. Cover has keyholes for easy removal without entirely removing screws.

Sold thru leading distributors. Write for new complete line Catalog.

THE HUENEFELD CO.

2703 Spring Grove Avenue CINCINNATI 25, OHIO

Inclined Armature Holder Has Clamp-on Feature

Armature holders, made from ⅜-in. strap iron, may be clamped to the angle-iron frame beneath any bench in Riles Armature Winding shop at Roanoke, Va., simply by placing the base assembly around the lip of the bench, inserting a holding bolt into a frame-drilled hole at the desired location (see arrow), then tightening up a wing nut from the inside of the angle lip.

Since the yoke-holder is constructed on an inclined plane and since the yoke is pivoted at midpoint, the assembly can be positioned or revolved at will during the winding operations.

WINDING YOKE, constructed on inclined plane and pivoted for easy turning, has mounting frame of strap iron which may be secured to bench top at any location by. . .

SLIPPING BRACKET over edge of bench, inserting holding bolt into frame hole at desired location, then tightening wing nut from inside of framing angle.

NOW! ...a 4′ x 4′ Recessed Unit
to complement Sylvania's New Troffer Series

Now at your command—shallow recessed fixtures in 1′, 2′ and 4′ widths to fit all modern ceilings.

Sylvania's new Troffer Series represents completeness in every sense of the word. Three separate housing designs are available to fit quickly and easily into every type of ceiling construction. You get complete choice of shieldings in both one and two foot widths—and in four and eight foot lengths. Matching incandescent Accent Units allow for pattern lighting or the creation of special effects.

The advanced features found in Sylvania's Troffer Series—shallowness, concealed hinges and latches, variety of housings and shieldings, snap-up hanger and many others—are typical of the inherent advantages built into each and every Sylvania fixture line.

Take a look at Sweet's Architectural File for a quick review of Sylvania's complete and modern line. Better yet—send for a complete fixture catalog today. Leaf through it and you'll soon discover the wide choice of fluorescent lighting equipment offered by Sylvania.

To complement this Troffer Series and to expand the design potential of recessed lighting systems, Sylvania now offers a versatile 4′ x 4′ shallow recessed fixture featuring the same clean, smart appearance and the up-to-date design advantages which permit simpler and faster installation. This attractive 4′ x 4′ unit places another distinctive and useful lighting tool in your hands.

For complete information on Sylvania's Troffer Series and 4′ x 4′ units, write to:

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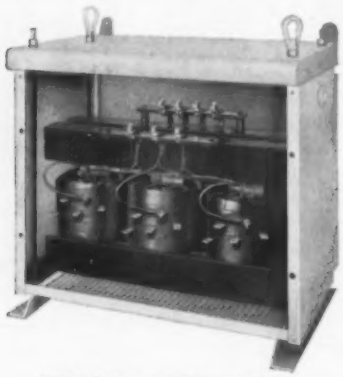
Sorgel dry-type transformers are most practical

To step down the higher distribution voltage to utilization voltage in institutional, commercial and industrial buildings, it is important that high efficiency transformers are installed at load centers. SORGEL dry-type transformers are the most practical for this purpose. They require little or no maintenance; no liquid to check or replenish; no vault required; small and compact; easy and economical to install. Sorgel dry-type transformers provide the highest efficiency, which reduces operating costs.

Easy and Low Cost Installation

All self-contained in a single unit—either single phase or 3-phase—with simple connections to make. No separate mounting brackets or junction boxes to make or buy. Substantial wall brackets, or floor mounting base, are an integral part of Sorgel transformers. Roomy connection compartment. Solderless terminals.



45 Kva 3 phase transformer with taps. Interchangeable wall or floor mounting. Connection compartment panel removed.

Substations

The same quiet SORGEL dry-type or Askarel-cooled transformers, in ALL ratings up to 10,000 Kva and up to 15,000 volts, are also incorporated in substations. Procurable with any type or make of switchgear, and from any substation manufacturer.

Sales engineers in principal cities. Consult the classified section of your telephone directory or communicate with our factory.

Quietest Operation

SORGEL sound-rated dry-type transformers are so quiet in operation that there is no disturbing hum. They are particularly adaptable for installation in hospitals, schools, office buildings, stores, and buildings where sound level is an important factor—as well as industrial applications. Therefore, they can be installed in almost any convenient place, inside of buildings, close to the load center. This results in shorter feeders, better voltage regulation, more efficient distribution, and lower wiring cost.

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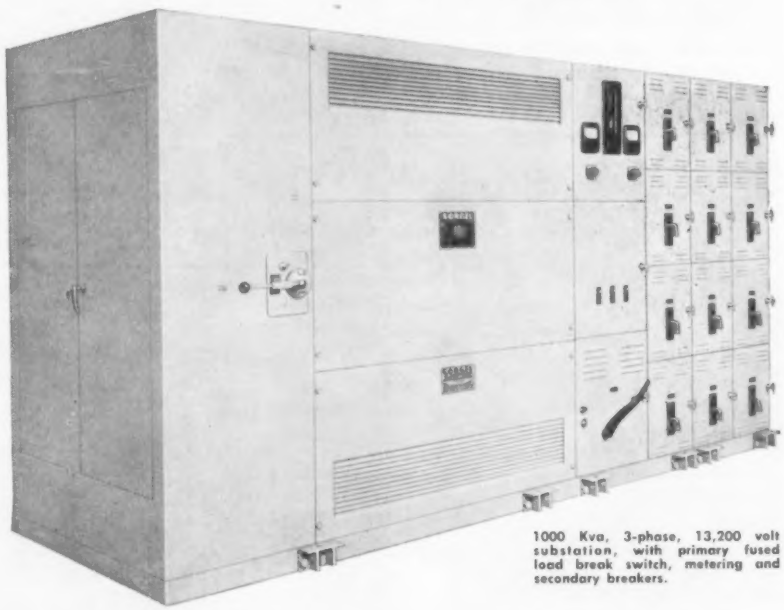
SORGEL transformers are guaranteed to carry the full rated load continuously at high efficiency. They are so liberally designed that they can carry an overload during an emergency at a safe operating temperature.

Complete line of dry-type transformers for every purpose

¼ Kva to 10,000 Kva — 120 to 15,000 volts

Also special transformers and saturable reactors



1000 Kva, 3-phase, 13,200 volt substation, with primary fused load break switch, metering and secondary breakers.

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Over 40 years' experience in the development, manufacturing and application of transformers

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Product News

Starter **(1)**

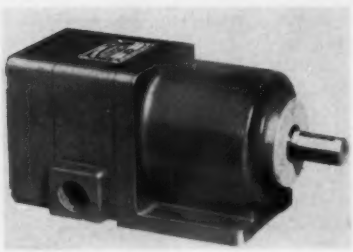
A new starter which gives fuseless fault protection on high voltage motor drives has been announced. Interrupting capacity of the fuseless ZHA starter is 100,000 kva at 2400 volts, 150,000 kva at 4800 volts. For inspection and maintenance, the phase barrier and arc-chutes draw out horizontally, making front and rear contact tips accessible. A 3-way doorlatch, interlocked between the disconnect and contactor interlocking system, provides personnel safety. Disconnect is gang-operated. When door is open, disconnect blades are visible in open and grounded position. Bulletin 8130 is available.

Electric Controller & Mfg. Co., A Division of Square D Company, 4500 Lee Road, Cleveland, 28, Ohio

Industrial Fixture **(2)**

New industrial lighting fixtures, called Wyteliner, are available with Kolorkode. Red units are used to identify exits and fire protection equipment; green are used for general aisles, traffic lanes, and other through-passageways; yellow to identify stairs, curbings, dead ends, or other dangerous areas. Kolorkoded units can also be used to identify specific operations in the production line, and to designate or differentiate particular plant areas, storage sections etc. Fixtures are for 430, 800 or 1500 ma operation. The 800 ma units use new "HO" high output lamps; 1500 ma fixtures utilize "VHO", "SHO" or Power Groove lamps. Reflector units are offered in white porcelain enamel, baked-on white, or Alzak aluminum. Literature is available.

Edwin F. Guth Company, 2615 Washington Blvd., St. Louis 3, Mo.



Switch **(3)**

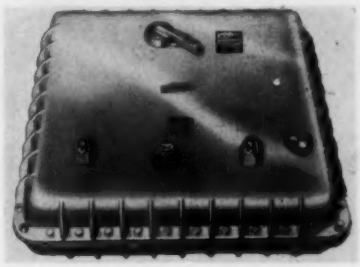
New Bulletin 2210 centrifugal switch with an overall adjustable speed range from 70 to 5000 rpm, and the operating speed adjustable while switch is running. Measuring 7¾ ins. long by 3-9/16 ins. high by 3¾ ins. wide, the type C switch is housed in an enclosure molded of glass fibre reinforced polyester resin. Two separate sets of contacts can be adjusted for operation at different speeds so that two separate operations can be controlled from one speed sensitive switch.

Euclid Electric & Mfg. Co., Madison, Ohio.

Enclosure **(4)**

A new weatherproof enclosure which provides complete protection for both operating personnel and switchboard. Design consists of a basic unit with an outside door at each end. As additional units are added, the end trim is removed, the additional units inserted, and the end trim replaced on the last unit. For each integral section of switchboard, only two outside doors are required. Inside, the switchboards are located on each side of a center aisle. Switchboard equipment is mounted on inside doors, which swing into the aisle to allow access to rear of switchboard. Fluorescent lighting across the top of the unit provides shadowless lighting.

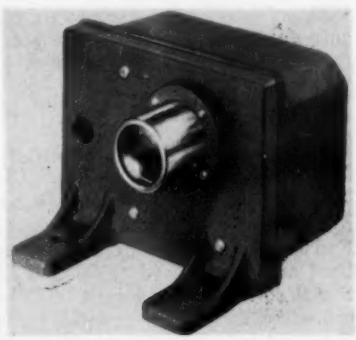
Westinghouse Electric Corp., Pittsburgh 30, Pa.



Motor Starter Enclosures **(5)**

Two new series of motor starter enclosures designed for hazardous locations are available. Series XMS has been designed to incorporate standard across-the-line starter equipment in all sizes. Series XMCS combination starters are available with all starter sizes and protective equipment. Features are mounting lugs; lock-out arrangements; operating handles; drains and breathers; controls, protective guards for reset buttons, and hinged lids. Units are designed for use in Class I, Group C & D; Class II, Group E, F & G. They are UL and CAS approved.

Killark Electric Mfg. Co., Vandeventer and Easton, St. Louis 13, Mo.



Control **(6)**

Tubeless photoelectric control with magnetic amplifier, designated BM1, requires 10 footcandles minimum light with .04 second minimum dark time and .04 second minimum light time. Control relay energizes when light is on the cad cell sensing element. Relay contacts are DPDT, silver cadmium oxide, rated 10 amps at 115 volts ac, non-inductive load. Housing is cast aluminum with splashproof gasket seal, tapped for ½-in. conduit.

Autotron, Inc., P. O. Box 722, Danville, Ill.

Speed Drive **(7)**

New adjustable speed drive in ratings from ¾ to 7½ hp with a stationary field construction. Both the ac motor and eddy current clutch are built into a common housing. Drive shaft, height and diameter dimensions are the same as a standard motor of comparable rating. Motor end brackets are now interchangeable with standard flanges and units can be flange-mounted to the driven machine for further space saving. It is suitable for continuous operation at full load (constant torque) in ranges as high as 34:1 and for intermittent use from 0 to full speed, or any rpm in between. A feature of the standard Adjusto-Spede drive is a tachometer feedback circuit that continually monitors the drive shaft and automatically corrects speed as required. Bulletin 2750 is available.

Louis Allis Co., Milwaukee 1, *Wis.*

Range Hoods **(8)**

Four new pre-wired ventilating range hoods include a "Hide-A-Fan" hood, radio hood, built-in oven hood and island hood. Featured in the Hide-A-Fan hood is a built-in pre-wired fan totally concealed under the hood. Design permits horizontal and vertical installation behind cabinets. Vertical installation through cabinets requires 3¼ ins. by 10 ins. for a standard duct. It comes complete with a 10-in. fan with pressure type blade, aluminum filter and special Venturi design. It has 3-speed pushbutton control, mitered edges, a recessed light with glass diffuser lens, and is available in three lengths, five finishes. Island hood is designed to exhaust heat and fumes on both sides of island type ranges. It comes with an 8-in. fan and includes 3-speed pushbutton control, mitered edges, a recessed lens-covered light and is available in two lengths and finishes. Built-in oven hood serves to protect cabinets from damage. It is available in three lengths and one finish and features an exhaust blower, removable filter and single speed pushbutton switch, and can be used for either vertical or horizontal exhaust. Radio hoods feature a built-in 5-tube super heterodyne radio with components specially designed to withstand high temperatures, 3-speed pushbutton control, mitered edges and a recessed light with glass diffuser lens. It is available in three lengths and four finishes.

Berns Air King Corp., 3050 *N. Rockwell St., Chicago* 18, *Ill.*

Troffers **(9)**

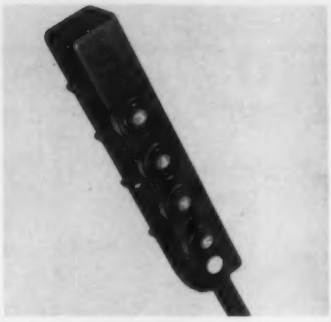
Almost 200 different sizes and types comprise the new L.P.I. Variform line of fluorescent lamp troffers. This is a new, modular designed recessed luminaire 2- by 2-ft and 2- by 4-ft utilizing 2, 3, 4 or 6 24- or 48-in. fluorescent lamps. These 2-ft wide troffers are available with flush, snap-in, lay-in or flange construction and are designed to properly recess in any of over 60 different types of ceilings. Six different diffusers are available.

Lighting Products Inc., Highland Park, Ill.

Brackets **(10)**

New secondary lead brackets have been designed for attachment to the bottom flange of transformers and are particularly useful on cluster-mount installations. Stud-bolt construction, wrench-flats on insulator stud, and self-locking cotter pins simplify assembly and installation. Locknuts and 3-point contact between transformer, mounting strap, and insulator stud insure a rigid installation that will not loosen. All parts of bracket have corrosion-resistant galvanized surfaces.

Line Material Industries, McGraw-Edison Co., Milwaukee 1, *Wis.*



Pushbutton Station **(11)**

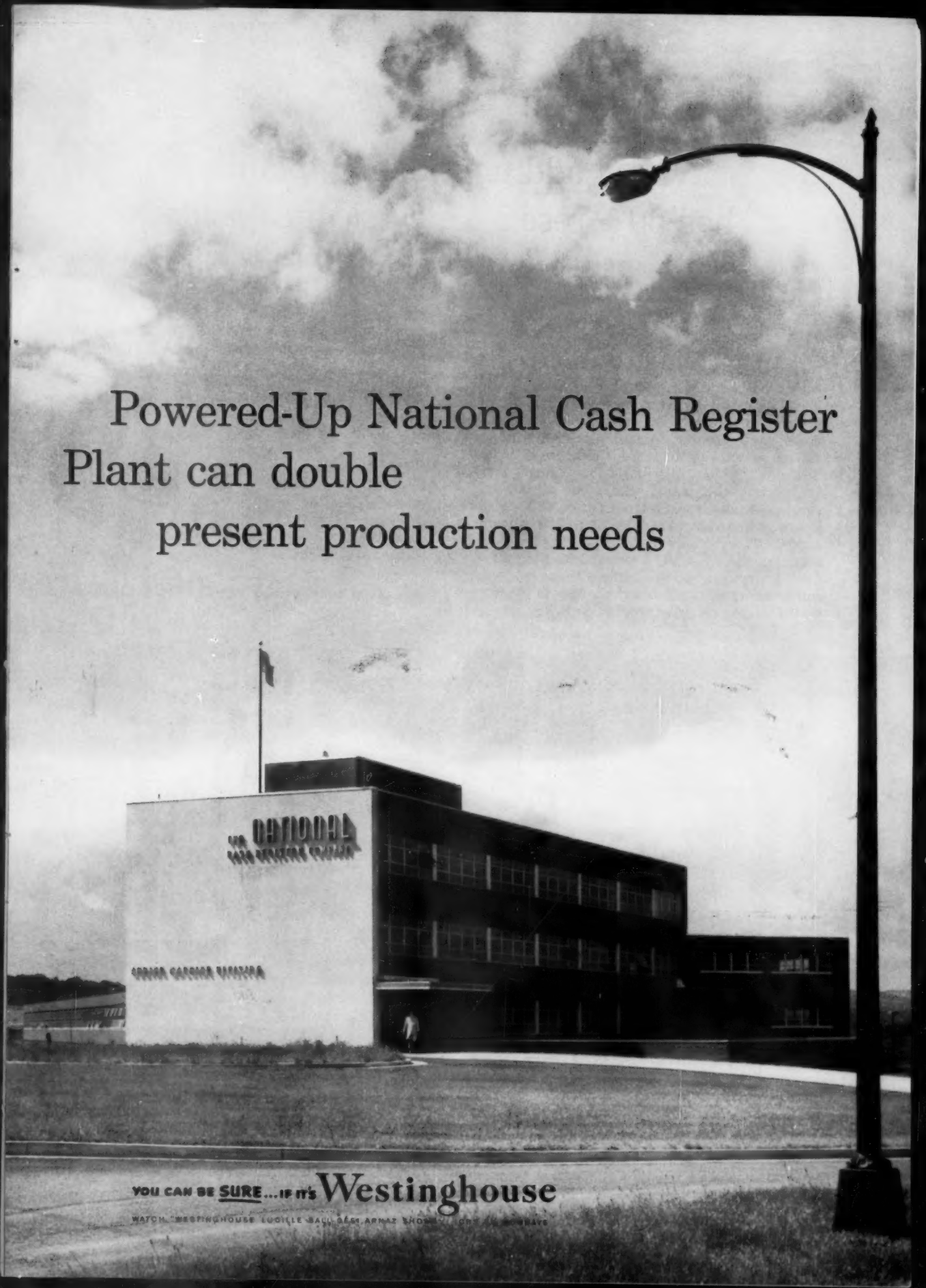
A new pushbutton station with Neoprene housing which features waterproof, non-corrosive, construction, is available in either 3- or 4-button models. Special grommets are supplied with each unit to fit several cable sizes. Each button is an integral part of the housing that completely encloses the snap acting switches and protects them from water and weather. A specially designed ring-shroud protects each button from accidental action from any lateral direction.

Electrical Products Division, Joy Manufacturing Co., 1201 *Macklind Ave., St. Louis* 10, *Mo.*

Telephone **(12)**

A pushbutton telephone, known as the "Call Director", is a low, button-studded unit with hand receiver cradled at its side. At the touch of a button, it can provide interoffice communication, arrange conference calls, and "add on" other extensions to incoming calls. Two models are available—one provides up to 18 pushbuttons and the other up to 30. Clear plastic pushbuttons light up to indicate incoming calls, lines in use, and lines on which calls are being held. Names and numbers beside the buttons appear in rectangular windows. Slanted operating panel permits easy reading.

American Telephone and Telegraph Co., 195 *Broadway, New York* 7, *N. Y.*


Powered-Up National Cash Register
Plant can double
present production needs
YOU CAN BE SURE...IF IT'S Westinghouse

Cover photo — Top: New National Cash Register Co. Adding Machine Division Plant, in Ithaca, New York. Westinghouse Type OV-20 outdoor lighting is used for the building approach and parking area.

New adding machine plant has 50% reserve electrical capacity

When the Ithaca, N. Y., Adding Machine Division of The National Cash Register Co. found its existing plant inadequate, a new plant site was secured. The design and planning for the new plant provided more efficient production methods and future plant expansion as required.

Once space requirements were satisfied, electrical power needs were detailed. An all-Westinghouse electrical distribution system was specified to meet these needs. A 2000/2300-kva, double-ended power center, located near the middle of the manufacturing area, feeds ten runs of plug-in bus duct which distribute low-voltage power throughout the plant. Six runs of 600-amp, three-pole plug-in duct are used for 480-v distribution, while four runs of 600-amp, four-pole duct supply 277 wye/480 v for both lighting and power requirements. Use of Westinghouse plug-in bus duct provides a flexible, efficient system which can be easily adapted to any changes in the automated adding machine production line.

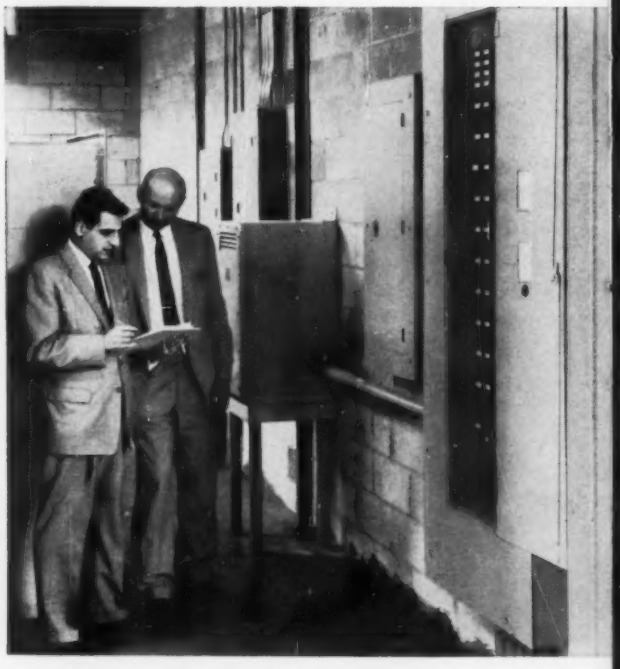
The new Ithaca plant has 50% more electrical capacity than is required by present production needs. The new 146-acre site (as compared to the previous six acres) is ample for anticipated space requirements, while the electrical system capacity can be doubled simply by utilizing the provisions for expansion and the spare equipment now installed. An interesting example of the new plant's expansion possibilities is that the present plant structure can be extended 600 more feet to the back. The location of the installed power centers will allow any necessary new feeders to be installed with minimum distance and voltage drop. In some cases, present bus duct runs can be extended into the new area.

Westinghouse worked closely with the architect, consulting engineer, general contractor, electrical

(*continued*)

YOU CAN BE SURE...IF IT'S **Westinghouse**

Conference room discussion includes Charles T. Hansen, Westinghouse Sales Engineer; John M. Schweiger, Schweiger, Heapy & Associates, Consulting Engineers; James Miller, Westinghouse Construction Sales Engineer; Clair Dean, Buffalo Electric Co., Electrical Contractors and Westinghouse Distributor; Ed Likens, Professional Engineer, Lorenz & Williams, Architects and Engineers; and C. W. Vail, Plant Engineer, Adding Machine Division of The National Cash Register Co., Ithaca, N. Y.



J. Victor Bagnardi, Ithaca representative of Lorenz & Williams, and John M. Schweiger are shown in electrical equipment room. On wall facing them can be seen four Westinghouse panelboards and a Westinghouse 50-kva, 480-v primary to 120/240-v secondary, single-phase, DS-3, dry-type transformer. Two of the panelboards are NLAB 120/240v, one is a NHIB 277/480v, and the opened panelboard in the foreground is a CDP 277/480v. J-94087-2

General plant view shows multiple runs of Westinghouse 2WVO-40R, 277-v fluorescent lighting and 600-amp copper plug-in bus duct. Plug-in units shown are circuit breaker type. Plug-in bus duct and circuit breaker plug-in units are standard requirements in The National Cash Register manufacturing plants.

Clair Dean, John Schweiger and C. W. Vail discuss details of Westinghouse 2000-kva, double-ended (one 1000-kva Inerteen® transformer each end) power center. Incoming voltage of 4800 is reduced to 480 wye/277. Each transformer has provision for 150 additional kva, so only fans need to be added when increased rating is needed. Four spare DB breakers are installed in board to take care of future load and, in addition, four cells are equipped to receive breakers when needed. (Note new switchgear design with three-position DB circuit breakers. Visible positioning tells at a glance if breaker is in "ON," "TEST" or "OFF" position. New "TEST" position allows testing of breaker in switchgear cell with complete safety.)

J-94087-3

Clair Dean and Charles Hansen examine three Westinghouse Class 11-204 nonreversing combination Life-Line® starters which provide control and overload protection for the motors in the equipment room.

50% reserve electrical capacity *(continued)*

contractor and The National Cash Register Co. engineers in selecting the equipment which provides for present and future electrical needs. Westinghouse can also help you with any of your electrical planning and construction requirements. See your Westinghouse distributor, or write: Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa.

J-94087-4

Owner: The National Cash Register Co., Dayton, Ohio

Architect: Lorenz & Williams, Architects and Engineers, Dayton, Ohio

Consulting Engineer: Schweiger, Heapy & Associates, Dayton, Ohio

General Contractor: Streeter Associates, Inc., Elmira, N. Y.

Electrical Contractor: Buffalo Electric Co., Inc., Buffalo, N. Y.

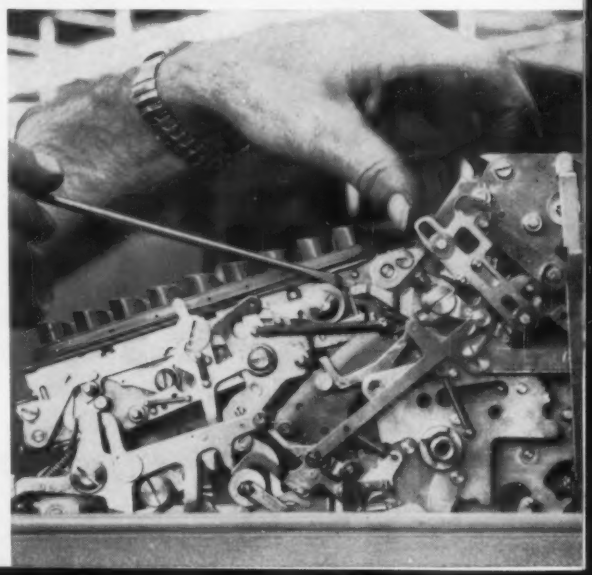
Westinghouse Distributor: Buffalo Electric Co., Inc., Buffalo, N. Y.

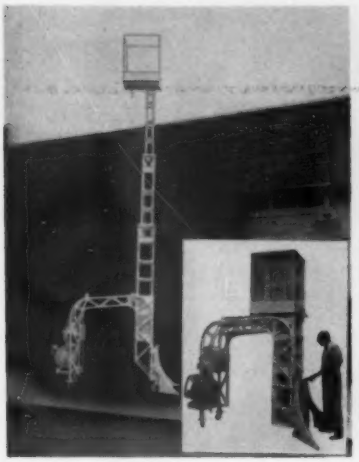
YOU CAN BE SURE...IF IT'S **Westinghouse**

WATCH "WESTINGHOUSE LUCILLE BALL DESI ARNAZ SHOWS" CBS TV MONDAYS

Over 200 Pages Westinghouse Data in Sweet's Construction File. (S)

Close-up view of adding machine mechanism as manufactured in Adding Machine Division of The National Cash Register Co.





Scaffold **(13)**

A new straddle scaffold especially designed for use over desks, machinery, tables, seats, etc., for all overhead maintenance work. It may be built to meet individual requirements as to size of work platform, and height to be reached. It is of all welded steel construction and entire unit folds for storage.

Atlas Industrial Corp., 849 39th *St., Brooklyn, N. Y.*

Corridor Light **(14)**

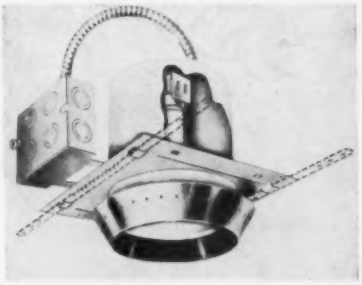
A new corridor light for use in schools, hospitals, office buildings and home. Unit features a plastic diffuser with high light transmission and wide distribution. It is furnished in 4- and 8-ft tandem sections for individual or continuous runs, and also may be had with gasketing. Literature is available.

Neo-Ray Products, Inc., 315 *East* 22d *St., New York, N. Y.*

Battery Chargers **(15)**

A complete line of new silicon-rectifier battery chargers has been introduced. Using an electrical rectifying system for converting ac directly to the dc required for battery charging, the new units are controlled by a magnetic amplifier with a sensing control circuit which automatically maintains the proper charging voltage at the battery terminals. Chargers are for use with stationary batteries in electric utility service, in emergency power, emergency lighting and in other float-charge battery applications. Designed for floor, wall or rack mounting, the chargers come in 27 basic models, for use with batteries having from 11 to 62 cells. Both single and 3-phase units are available, having an output range of from 1 to 400 amps. Single-phase units can be operated at 115 or 230 volts; 3-phase units at 230 or 460 volts. All models are equipped with voltmeters, voltage-adjusting potentiometers and an ac failure alarm relay.

Exide Industrial Division, Electric Storage Battery Co., Philadelphia, Pa.



Lighting Fixtures **(16)**

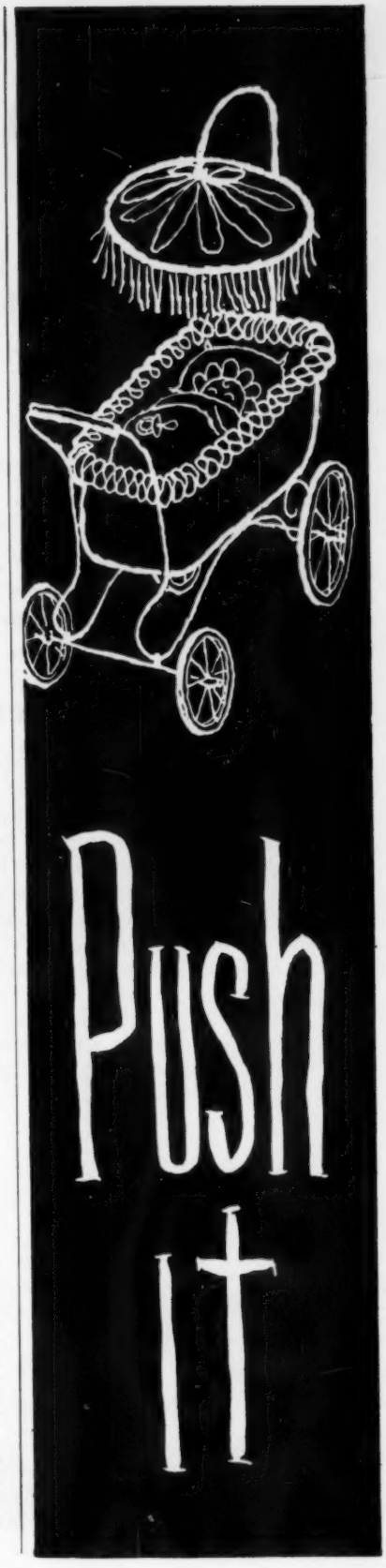
A new line of recessed lighting fixtures, named "Jiffy", can be wired below the ceiling. Other features are a "Flip-top" hinged junction box, "Thum-lok" clamps, a levelizer socket for bulb alignment, concealed "traxion" hinging that permits fast relamping and swing out reflectors. The line has a new optically designed parabolic reflector which fits into a special frame.

Progress Manufacturing Co., Castor Ave. and Tulip St., Philadelphia 34, *Pa.*

Storage Battery **(17)**

New replaceable-cell storage battery are now available for industrial, marine and utility service, including lighting, diesel and gas engine starting, alarm systems, instrumentation, electric trucks and substation breaker tripping work. Heat-resistant cells are made of Koppers "800" Polystyrene. The replaceable-cell feature permits any voltage or amperage to be set up by adding or removing cells. This feature also permits individual cells to be replaced in case of cell failure.

Scranton Cellomatic Battery Corp., Archbald, Pa.



NELEX HEATER UNITS **Perform efficiently and economically**

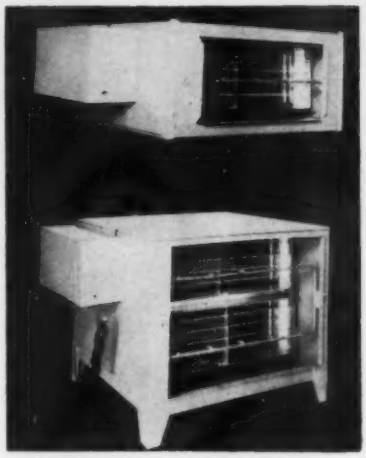
Nelex Heater Units are literally the heaters of a thousand uses. Since Nelson introduced Nelex Heater Units in 1954, the only limit to their use has been the user's imagination. They have been used to solve countless industrial heating problems. If electricity is available and heat is required, these versatile units can be used.
Most Nelex Heaters are used at present in these two broad categories:

1. Installed on piping to maintain the temperature of process fluids and to prevent liquids in the pipes from freezing.
2. Installed in concrete structures or slabs for the purpose of de-icing and/or snow removal.

Write for Bulletin 1603. This brochure gives you complete information and performance characteristics of Nelex Heater Units.

At Nelson . . . . *quality* comes first!

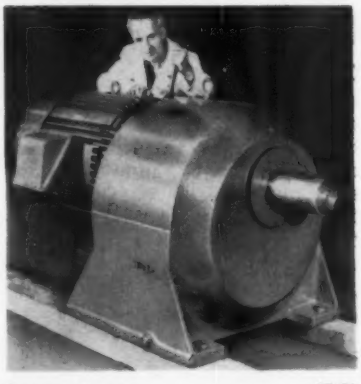
NELSON *Electric* MANUFACTURING CO.
TULSA, OKLAHOMA



Electronic Air Cleaner **(18)**

Two new models of the Precipitron electronic air cleaner for home use are designed to clean air in homes with four to ten rooms. A newly designed power pack incorporates a selenium rectifier; a simplified wiring circuit; a rheostat for regulation of incoming line voltage; and a pilot light that switches ON when unit is not operating. These cleaners can be applied to homes with year-round air conditioning systems. Units are rated at 25 and 30 watts.

Westinghouse Sturtevant Div., Westinghouse Electric Corp., 200 *Readville St., Hyde Park, Boston* 36, *Mass.*



Gearmotors **(19)**

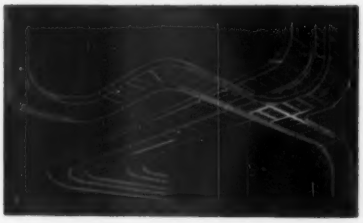
Two new large-size gearmotors, known as "GearMotoR Drives", sizes J and H, are rated up to 200 hp. Double, triple and quadruple reductions are available in AGMA ratios ranging up to 440:1. Gears, shafting and bearings all meet AFMA standards. Standard NEMA D flanged motors and standard foot mounted motors are available.

Philadelphia Gear Corp., 3620 *G St., Philadelphia* 34, *Pa.*

Switch (20)

A new auxiliary switch (Q-10) for circuit breakers and switchgear applications. It can be individually adjusted in steps of 15 degrees in the field without disassembling. Switch is being used on the 4.16-kv Ruptair circuit breaker (Type MA), on the 600-volt, low-voltage air circuit breaker (Type LA), and is being adapted to other A-C breaker lines. Switch is available for all secondary voltages of 24, 48, 125, 250 volts dc, and 110, 220, 440 volts ac.

Allis-Chalmers Manufacturing Co., Milwaukee 1, *Wis.*



Cable Trays (21)

A new complete line of standard cable trays, made in an all-welded construction from either corrosion resistant aluminum alloy extrusions or from roll formed steel channels. Cable trays are designed for support of heavy loads of small power and control cables installed in "free air" over long spans. Trays are made with 4-in. deep sides and have cross-rungs set at bottom. Rungs are spaced on 9-in. centers to give frequent support. Standard widths for units are 6, 9, 12, 16, 20 and 24 ins., with standard straight lengths of 12 and 24 ft. Horizontal and vertical bends of 15, 30, 45, 60 and 90 degrees are available as standard items. Brochure is available.

Husky Products, Inc., 5300 *Vine St., Cincinnati* 17, *Ohio*

Generator (22)

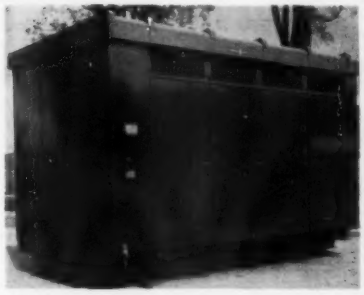
A new portable engine generator, called the Winco Mite, has been added to this line. It delivers 1500 watts of electric power for ac and ac/dc portable tools. Unit is equipped with the automatic Conserv-er Idling Control which brings engine to full speed when power is called for, otherwise engine runs at a slow idling speed to save fuel and reduce engine wear. It is powered by a recoil starting 4-cycle engine.

Wincharger Corp., Sioux City, Iowa.

Distribution Units (23)

Sealed units for electrical distribution in trailer parks. Features are accessibility to interior; generous wiring space inside; adequate service entrance knockouts at bottom, and equipped with sub-feed lugs and weatherproof, twist-lock type receptacles. Multi-lug connections permit cascading from one unit to another without using a separate pull box or terminal cabinet. Units are weatherproof and tamper proof, constructed of galvanized steel and finished in green hammer tone baked enamel. Meters can be read through the Visa-Ports without lifting cover or opening door. Circuit breakers are concealed behind gasketed access ports. Bulletin 5M159 is available.

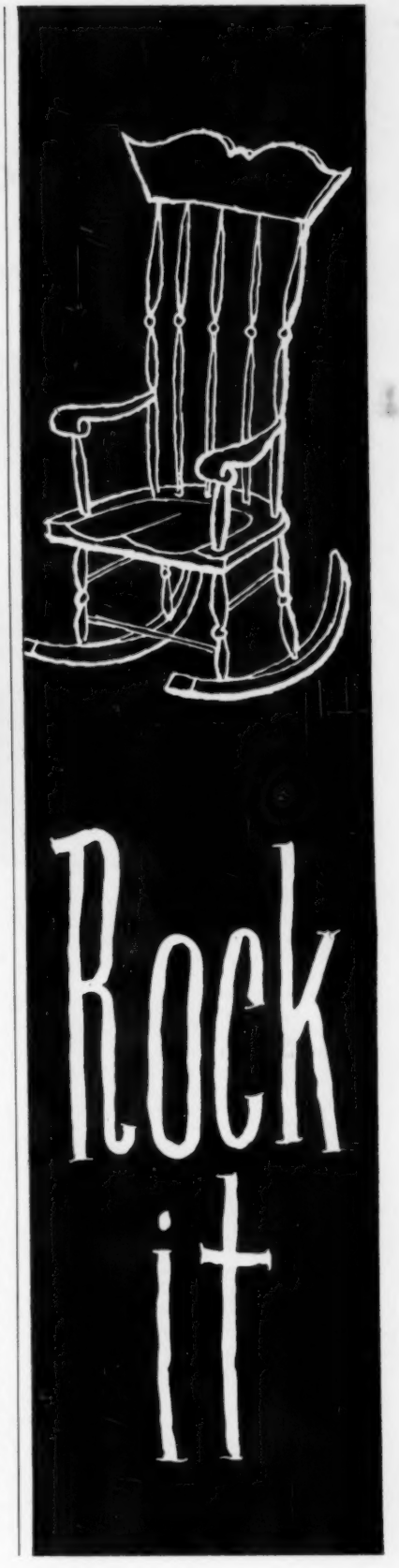
Myers Electric Products, Inc., 3019 *S. Vail Ave., Los Angeles* 22, *Calif.*



Capacitor Equipment (24)

A new high voltage housed capacitor equipment comprised of standard sections mounted on a continuous base is now available. Basic section contains 1200 kvar of capacitors and interlock and grounding device. Additional capacitor sections rated 1200 kvar each can be included in the factory-assembled equipment or added in the field to bring the total kvar rating to 3600 for a 5 kv class equipment, and up to 6000 kvar for a 15 kv equipment. The capacitors are mounted in a horizontal position behind housing doors, making bushings and fuses accessible for inspection and maintenance. Floor screens and louvered upper vents provide weatherproof ventilation and prevent the entrance of rodents and birds. A thermostatically controlled fan at the bottom of each 1200 kvar capacitor section operates when the ambient temperature actuates a factory preset thermostat. An auxiliary thermostat for an alarm or breaker trip circuits is also provided.

General Electric Co., Schenectady 5, *N. Y.*



IT TAKES A SPECIALIST LIKE STROMBERG-CARLSON

to provide the most modern high school with a **modern** communication system

Faragher & Macomber, Architects

When Rause Fluorescent Service Co. chose a Stromberg-Carlson sound-communication system for the new East High School in Rochester, N. Y., they provided the utmost efficiency for the school and were assured a profit that would not dwindle away.

Yes—you, too, can be sure that every Stromberg-Carlson school communication system will be satisfactory to you and your customer. You can bid Stromberg-Carlson with confidence because:

- **Installation assistance and supervision is available to you from factory-trained sound distributors in every major market.**
- **Service and maintenance problems are negligible—as proved by thousands of installations now in operation.**
- **Field sales engineers are at your service for consultation at any time.**
- **Factory engineering staff is at your service to assist in solving complicated and tricky installations.**
- **Every specification can be easily met, because Stromberg-Carlson systems are custom-engineered from standard components.**
- **Easier, faster installation due to modular construction from standard components.**

Consider these and many more Stromberg-Carlson advantages next time you bid on a sound installation—in a school, industrial plant or commercial building—new construction or existing structure.

Bid Stromberg-Carlson and you bid competitively, with assurance of a good profit and an installation that will add to your prestige!

For further information, or name of our local representative, write—no obligation.

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ELECTRONIC AND COMMUNICATION PRODUCTS FOR HOME, INDUSTRY AND DEFENSE . . . INCLUDING HIGH FIDELITY CONSOLES; SCHOOL, SOUND, INTERCOM AND PUBLIC ADDRESS SYSTEMS

Drum Switch (25)

Type "DR" drum switch to be used for across-the-line starting and reversing of ac polyphase squirrel cage motors. Switch may also be used with single phase motors built for reversing duty; and dc shunt, series, and compound motors. Size 00, with 3 poles arranged to break two lines to the motor, is rated 1 hp maximum at 115 volts ac, single phase; or 220 volts ac, polyphase. Size 0, with contacts arranged to break three lines to the motor, is rated 1 hp maximum at 115 volts ac, single phase to 2 hp maximum at 440-550 volts ac, polyphase. Both sizes are supplied with NEMA 1 enclosures designed for surface mounting direct to the machine.

Arrow-Hart & Hegeman Electric Co., 103 Hawthorn St., Hartford 6, Conn.

Enclosures (26)

New "Shelter-Clad" walk-in enclosures which provide complete protection against the elements for men and 200- to 5000-volt motor control in outdoor installations. Enclosures consist of two facing rows of Type H motor controls bridged by a metal roof. Backs of control cabinets form outside walls of unit. A 5-ft wide aisle extends the length of enclosure which has doors at each end. Basic unit can consist of any number of facing cabinets and any number of pairs of cabinets can be added or removed. Cabinets can also be obtained without instrumentation and arranged to provide office or storage space. They can be provided with lights and bus ducting can be from overhead, below or through side. Units meet NEMA 3 standards for weather resistance.

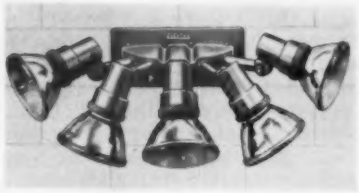
Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.

Channel System (27)

A new method of enclosing current collecting systems in channels in which the conductors are completely covered with steel plates. This "slitless channel" application has no opening running the length of the system. A cam and roller arrangement raises each steel cover plate in turn high enough to allow the collector staff to pass along, a height of approximately 2 ins. Designed primarily for harbor gantries, the system is now being applied to industrial plants. With this system equipment can travel in both directions while channel can

be laid in curves as well as straight lines. In most cases channel is installed below ground level in a concrete trough. Collectors may be positioned vertically in an underrunning or over-running manner in respect to rail or in a horizontal or sideways position.

Ringsdorff Carbon Corp., Box 22, East McKeesport, Pa.



Cluster Box (28)

A cast aluminum cluster box designed for recessed mounting in walls of brick, block or frame construction. Up to five medium or mogul base Steberlites can be attached to this unit for area lighting or parking lots, industrial storage areas, loading docks, protective lighting, etc. Will also accommodate Steberlites for PAR-46, PAR-56 and PAR-64 lamps. Junction box is same size as a standard brick. Face plate has five ½-in. tapped openings. Wiring compartment has a gasketed entrance cover. An auxiliary steel entrance box at rear permits conduit runs into and out of unit in any direction.

Steber Manufacturing Co., Broadview, Ill.

Cabinet (29)

A new type of branch circuit connection cabinet, designed for use as integral part of standard wireway runs, called "Safe-T-Taps". They permit the use of short lengths which may be connected to the "Safe-T-Tap" bus bars. Installation is recommended at intervals of approximately 40 ft. In addition, 3-phase power and single phase lighting can be drawn from the same wiring system. They are furnished fully equipped with 400-amp bus bars and solderless lugs, plus a full length removable screw cover to provide access to working area. They are produced in standard dimensions of 4 ins. long by 10 ins. wide by 8 ins. deep, with openings at both ends to accommodate 6- by 6-in. wireways.

Keystone Manufacturing Company, 23328 Sherwood Rd., Warren, Mich.

Pipe-Heating Units (30)

A new pipe-heating unit that replaces heat lost during the transfer of liquids through pipes up to 3 ins. in diameter. Prefabricated pipe-heating unit consists of a formed, steel sheathed tubular heater rated 600 watts, 120 or 240 volts, and is mounted on an aluminized reflector 3 ft long. Insulated with calcium-silicate, the reflector is covered by an outer coating of sheet metal. A bimetallic thermostat is mounted between the tubular heater legs and wired in series with the unit. Range of thermostat is 0 to 650 F.

General Electric Co., Schenectady 5, N. Y.

Hardware (31)

A new and complete line of hardware for aerial cable suspension is designed for use with spaced aerial cable clamps. Five basic designs offer a complete range of application and include a corner bracket and suspension assemblies for crossarms, close or extended tangents, and pole-tops.

Line Material Industries, McGraw-Edison Company, Milwaukee 1, Wis.

Electronic Control (32)

A new synchronous electronic control designed for use with small bench welders. Model 10E49-E-A controls the weld current of all types of resistance bench welders and is especially suited for resistance welding of small delicate parts. It is available for 115/230 voltage range, is equipped with two plug-in thyratron firing tubes. Thyratron contactor is rated at 12 amps at 50% duty cycle and with a 5-second averaging time. External cabinet dimensions of unit are 22 ins. wide, 15 ins. high and 10 ins. deep.

Robotron Corp., 21300 West Eight Mile Road, Detroit 19, Mich.

Corrosion Resistant Finish (33)

An improved silver-colored, corrosion resistant finish on electrical metallic tubing, formerly called Dualcote, is now called Dualbrite. EMT is manufactured with two protective coatings: first, zinc coating applied by the Sherardizing process which alloys zinc with steel, and secondly, a specially formulated corrosion resistant coating.

Walker Brothers, Conshohocken, Pa.

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Chase & Sons Inc.
26 Spruce Street
North Quincy, Mass.

Electroluminescent Lamps (34)

A broad line of electroluminescent "light bulbs," called Rayescent, is available for commercial applications. Basically, the Rayescent lamp consists of a sheet of glass with an electrically conductive coating and a phosphor layer. When voltage is applied, light is produced by the phosphor. Lamps will be available in standard sizes ranging from 2 by 2 ins. to 24 by 24 ins. They are available in green, blue and yellow. A standard 4 by 4-in. lamp consumes only .07 watt at 120 volts, 60 cycles. Rayescent lamps, when operated at frequencies higher than 60 c.p.s., require special auxiliary power supplies. Most any oscillator or frequency converter that gives essentially sine wave output can be used for this purpose, provided the rated voltage of lamp is not exceeded. When lamps are operated at other than 120-volt line voltages, a transformer of the proper current capacity may be used.

Westinghouse Electric Corp., Bloomfield, N. J.

Conduit (35)

Aluminum rigid conduit, couplings and 90-degree conduit elbows, approved by UL, meet the same size, shape and tolerance requirements as those for steel conduit. Nominal diameter sizes range from one-half through 6 ins. in standard 10-ft lengths. Larger diameters are available through special order. Conduit is chemically coated inside. Aluminum conduit is non-rusting, resistant to corrosion, non-sparking and non-magnetic.

Electric Conductor Div., Kaiser Aluminum & Chemical Corp., 919 *North Michigan Ave., Chicago* 11, *Ill.*

Ventilating Hood (36)

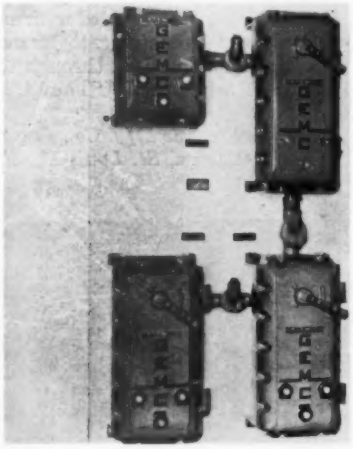
A new ventilating hood, called the "Retractable", is flush with the cabinets and out of the way when not being used. Light and fan turn on automatically when you pull hood out and turn off when hood is pushed back. Hood is geared and runs on nylon rollers. A variety of front panels are available for modern or traditional kitchen motif. Two-speed switch to control fan. Specially designed blo-fan power unit—100-watt concealed light.

Emerson-Pryne Co., Division of Emerson-Electric of St. Louis, 8100 *Florissant Ave., St. Louis* 21, *Mo.*

Lighting Unit (37)

A new shallow "Wrap-Around Plastolier" which reduces "blackout zones" in continuous runs. One-piece polystyrene diffusers provide plastic-to-plastic contact in continuous runs. The diffuser snaps into position over flanges on the metal housing. Flanges serve as hinges on which the diffuser can be lowered from either side for lamp maintenance. Uplighting is provided through the plastic shielding when unit is pendant mounted. Surface mounted it produces a modified uplighting. They are available in 2- and 4-lamp, 40-watt rapid start, and also in 2-lamp tandem units.

Metalcraft Products Co., Inc., Philadelphia 33, Pa.



Starters (38)

A new NEMA 7 explosion-proof enclosure has been designed to accommodate several combination starters assembled in a single enclosure. Each starter is provided with a disconnect switch or circuit breaker. A single control transformer can be included if required. Available in both cast aluminum and cast iron enclosures with push-buttons, selector switches, pilot lights and other control components mounted in the cover. Built in accordance with UL standards.

Gemco Electric Co., 25685 *West Eight Mile Road, Detroit* 40, *Mich.*

External Lockoff (39)

A new external lockoff arrangement is now a standard feature of manual starters in general-purpose enclosures. Lockoff makes it possible to lock the starter in the OFF position without removing the cover. All general-purpose manual starters are now furnished with both an internal lockoff on the operating mechanism, and an external lockoff which combines both the cover lockout and button lockoff features. Bulletin 2510BG is available.

Square D Company, 4041 *N. Richards St., Milwaukee* 12, *Wis.*

Circuit Breakers (40)

A line of cast aluminum explosion-proof circuit breakers are designed for Class I, Group C & D; Class II, Group E, F and G. All units are UL and CSA approved. The XCB Series are for breakers in frame sizes E, EH, F, J, K, KL, and LM. The EPCB Series are designed to take up to four single-pole quick-lag type breakers, two double-pole or one three-pole. Both series are furnished with mounting lugs.

Killark Electric Mfg. Co., Vandeventer and Easton, St. Louis 13, *Mo.*

Receptacle (41)

A new grounding Condulet receptacle, Type GCR, has been designed for flush mounting in aircraft hangar floors and aircraft aprons. It removes static electricity, providing a grounding path and making it safe to refuel and to perform repairs. Condulet is available for use with ¾ in. threaded or unthreaded ground rod, or with grounding lug for attaching to a wire grid.

Crouse-Hinds Company, Syracuse 1, *N. Y.*

Hood-Fan Combination (42)

A new pre-wired, Kitchen-Aire fan and hood combination, called Commander "400", is available in two finishes, coppertone and stainless steel. Package includes hood; built-in pre-wired 8-in. propeller-type fan, double light assembly with fan and light toggle switches; filter; matching reducer damper; and matching 24-in. length of duct. Hoods are available in 24-, 30-, 36-, 42- and 48-in. lengths.

Stewart Industries, Inc., 320 *East St. Joseph St., Indianapolis* 2, *Ind.*

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lists current cost prices of electrical construction materials and suggests resale prices to insure a fair profit to your business.

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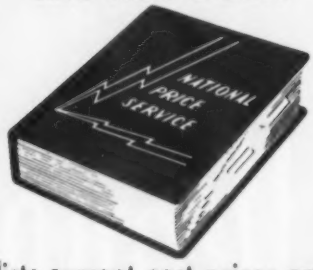

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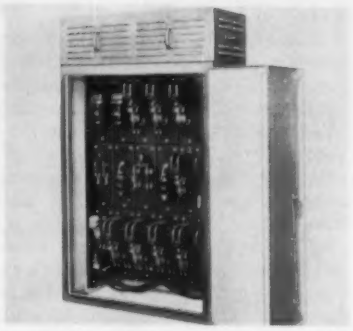


Hoist Controller **(43)**

New hoist controller, Form HWR, provides dc performance on ac cranes. Silicon rectifiers are used to supply dc power to a series-wound hoist motor and its series-wound brake. Rectifier units are mounted on top of controller. Circuit used in the HWR controller is the Wright dynamic lowering circuit. Positive over-hoisting protection is provided by Youngstown limit stops.

Electric Controller & Mfg. Co., Division of Square D Company, 4500 Lee Road, Cleveland 28, Ohio

Fluorescent Unit **(44)**

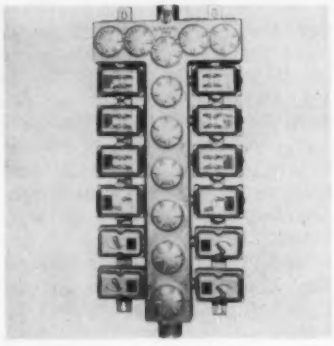
A new series of Gym Lites includes the 96-in. model for two rapid start power groove lamps, with porcelain enamel reflectors; also a full series of deluxe RLM models with upward component and finished in porcelain enamel, Series 81, for two or three 48-in. or 96-in. slimline or rapid start lamps. They are also available with baked white enamel finish. All models are basically an industrial-type design, with a heavy mesh guard. Mesh guard drops on hinges from either side for servicing. Mounting is by stem, chain or on surface.

All-Brite Fluorescent Fixtures, Inc., 352 Shaw Road, South San Francisco, Calif.

Wireholder **(45)**

New single-point, spool-type wireholders facilitate termination of triplex service drops to low-roofed structures. They may be mounted on roofs, vertical walls, or pipe masts up to 2½ ins. in diameter, wherever deadening of secondary conductors is required. Individual galvanized ferrous parts, assembled with stainless steel rivets, and a formed channel base insure high strength and long service life. Bracket is furnished with a clevis bolt.

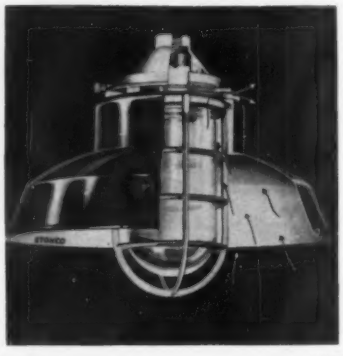
Line Material Industries, McGraw-Edison Co., Milwaukee 1, Wis.



Panelboard **(46)**

A complete line of explosion-proof panelboards has been added to this line. They are constructed of cast aluminum and can be built to fit individual job requirements. Available in a wide selection of sizes, they can be provided with any size protective equipment. Branch circuits can be brought through top or sides. Units are all UL and CSA approved.

Killark Electric Mfg. Co., Vandeventer & Easton, St. Louis 13, Mo.

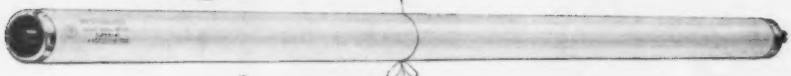


Fixtures **(47)**

New vaportight reflector fixtures are available in standard dome, shallow dome, deep bowl or angle types up to 200 watts and are designed for interchangeable use with this complete line. Built-in vents encircle the entire fixture. The complete line is UL and CSA approved for outdoor or indoor service.

Stonco Electric Products Co., 333 Monroe Ave., Kenilworth, N. J.

the work's lighter



when the light's brighter!

WESTINGHOUSE SUPER-HI™ FLUORESCENT LAMPS ARE 2½ TIMES BRIGHTER!

Rosie's just collected an armful of posies from the boss. Since they put in Westinghouse Super-Hi fluorescent lamps, everything's looked brighter (2½ times brighter than with regular fluorescents, in fact) and Rosie's efficiency has soared.

Of course what Rosie didn't know is that:

- "Ultralume"™ phosphors maintain maximum light levels for the life of the lamp.
- Special cooling chambers give *longer life*, as well as more light.
- New leads are chromium-vanadium plated to eliminate end-darkening.
- Smooth, slim design gives uninterrupted brightness all around the tube . . . much lighter weight for safer, easier handling.
- They're interchangeable . . . can be used in any fixtures designed for new high intensity lamps.

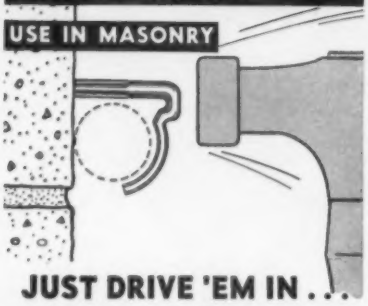
This all made the boss very happy, too. He found not only were morale and efficiency higher, but that he could save money while getting more light from the same number of fixtures.

Why not get the details for yourself? Just call your local Westinghouse agent, or write—Westinghouse Lamp Division, Dept. 57-L-5, Bloomfield, New Jersey.

YOU CAN BE SURE...IF IT'S Westinghouse

NEW HI TRADE MARK REG.
"DRIVE-STRAPS"
THE FASTER WAY TO HANG THINWALL AND RIGID CONDUIT, PIPE, CABLE, BX, etc.

USE IN MASONRY



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VERTICAL THREADS (hardened steel — electroplated). Drives like a concrete nail into concrete block, green concrete, cinder block, mortar and similar materials.

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HI TRADE MARK REG. HOLUB INDUSTRIES, Inc.
442 ELM ST. • SYCAMORE, ILL.

Bender (48)

A new portable hydraulic bending and pipe fabricating machine. The 2500-lb unit is mounted on two trailer-type pneumatic tired wheels and a castered front wheel. Bender can be moved by either pushing it like a dolly, pulling it behind a truck or hauling like a two-wheeled trailer. The machine has a built-in 20-ton ram-type hydraulic bending machine. It will bend electrical conduit pipe up to 2½-in. dia, solid bars up to 1½-in. dia, and angle forms. Hydraulic pump is driven by a 220-240-volt, 5-hp electric motor with plug attachment.

Walter P. Hill, Inc., 22183 *Telegraph Rd., Detroit* 19, *Mich.*

Plastic Tie (49)

A new plastic tie to bind industrial wiring harnesses is made of nylon base Moldarta material. Ratchet-like design makes plastic tie self-adjusting to a wide range of wire bundle diameters. Tooth form allows bending to a low limit of $\frac{3}{32}$-in. radius, while notched leader facilitates gripping the tie for tightening. Tapered surfaces at rear of ratchet buckle and $\frac{1}{8}$-in. long tapered surface permit ease in threading the leader through the buckle. The "V" ridge along the underside of the tie prevents side slip. Flat surface of leader eliminates danger of cutting into insulation of group of wires.

Westinghouse Electric Corp., East Pittsburgh, Pa.

Housing (50)

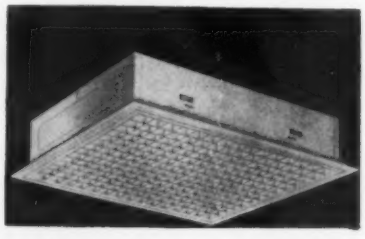
Shelter-Clad switchgear, designed to facilitate preventive maintenance of outdoor units during inclement weather. Weather-protected housing with a 75-in. wide aisle affords protection in all kinds of weather for inspection or on-the-spot maintenance. This work area makes it possible to check the breakers without exposure to weather and need for a transfer truck. The area, with light switch and utility outlet adjacent to doors at either end of unit as well as a light fixture over each breaker, provides control room atmosphere. Trunnion mounted potential transformers can be placed over breaker unit in superstructure for inspection and aisleway accessibility or they can be placed in an auxiliary cubicle when such is provided. Current transformers are located in breaker compartment behind a removable metal barrier and in front of automatic primary disconnect shutters. Condensation is eliminated by means of a thermostatically controlled space heater together with well directed air flow.

Allis-Chalmers Manufacturing Co., Milwaukee 1, *Wis.*

Thermostat

A new electric heat wall thermostat is named Type 1A65. A highly-sensitive thermal element, the control knob is exposed to both room temperature and radiant heat. In addition to heat range selection of 55° to 85°F, the unit has a "Cold" position on the dial. At Cold, one side of the power line is disconnected for shutdown. Unit mounts flush to wall, extending outward 1 in. Switch fits any standard 2- by 3-in. outlet box. Electrical rating is 2500 watts, 124 volts, ac; 5,000 watts, 240 volt ac.

White-Rodgers Co., 1209 *Cass Ave., St. Louis* 6, *Mo.*



Lighting Fixtures (52)

A variety of designs may be achieved with Series 52 and 53 fluorescent fixtures. Available in two basic sizes, 4- by 4-ft and 2- by 2-ft, in either recessed or surface mounted units. Series 53 is available in both sizes for shallow square surface mounting, while Series 52, also in both sizes, is for recessed installation. Both units are available in a wide selection of interchangeable shieldings.

The Frink Corp., 27-01 *Bridge Plaza North, Long Island City* 1, *N. Y.*

A jewel of a fixture

at a down-to-earth price

the wonderful WAKEFIELD

prismatic

Below: Actual size photograph of clear plastic lens.

the wonderful

WAKEFIELD® prismatic

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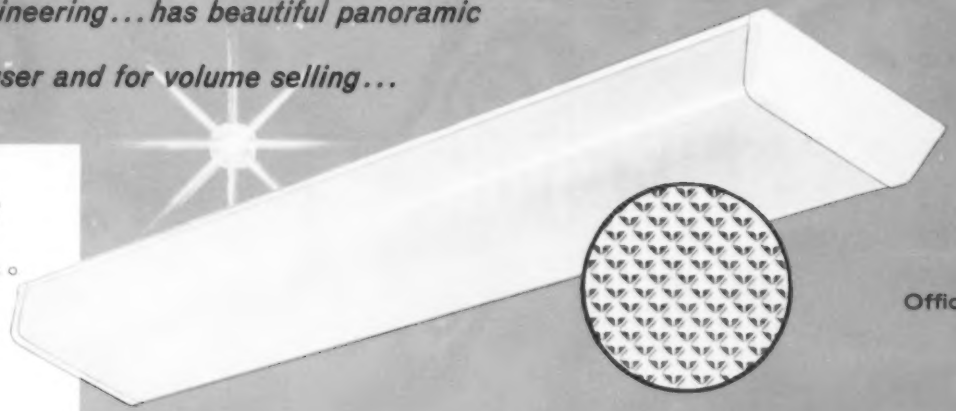
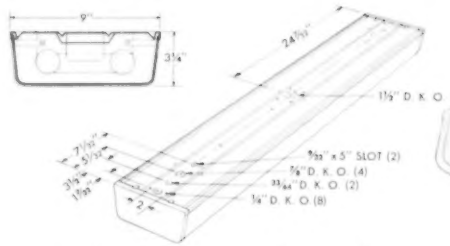
...is wonderful because it goes practically everywhere...installs in a jiffy...needs no engineering...has beautiful panoramic styling...is priced to delight the user and for volume selling...





Catalog Number	No. of Lamps	Description	Standard Weight	Package Quantity
R-214	2-F40T12/RS	Wakefield Prismatic	18 Pkd. 15½ Unpkd.	1

If your customer needs approximately 50 footcandles, install *one* Prismatic for every 40 square feet of area.

Suggest to your customer that he paint his ceiling white and his walls a light color.

eye-fi LIGHTING

Tear out this page—it's perforated for your convenience.

Thousands of interiors are waiting for the Wakefield Prismatic. **It's a natural for virtually all commercial, office and institutional areas. A beautiful, practical, inexpensive four footer with graceful one-piece clear plastic lens diffuser. All steel parts are white-enameled. Takes two Rapid Start lamps. Installs easily directly on the ceiling, singly or in continuous rows. IBEW, UL/CSA labeled.**

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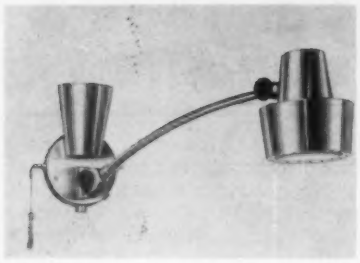


Wall Light **(53)**

A new multi-purpose wall light Model No. 617, for use in hospitals, hotels and motels, and dormitories. It is an adjustable reading light and also gives general indirect room illumination. Wall canopy contains a 6-watt night light and plug-in receptacle. Reflector is ventilated. May be supplied with 8-ft cord and plug set for existing rooms if outlet box is not available at proper location. Bulletin No. 58F is available.

Adjustable Fixture Company, 104 E. Mason St., Milwaukee 2, Wis.

Motor **(54)**

An oil-filled submersible motor for 4-in. well applications. The motor's supply of mineral oil continuously circulates around the windings with rotor movement transferring internally generated heat to the cool motor shell. A specially designed lead seal eliminates capillary action of lubricating oil. Shaft seal is of a specially designed carbon-ceramic construction. Stator windings on the new submersible pump motors are protected against electrical stresses and moisture with Mylar polyester film, selected Formex magnet wire and a special triple-dip and bake varnish treatment.

General Electric Co., Schenectady 5, N. Y.

Heaters **(55)**

Four new instant heating bathroom ceiling heaters, including recessed, surface mounted and the combination heater-fan-light and heater-fan models are available. Combination models include the "Trio-Lux," a 3-way combination incorporating a fan forced heater, light and exhaust fan in a single unit, and Model BH6L, a fan forced heater-light combination. Trio-Lux fits between joists. It take two 60-watt bulbs and comes complete with a special wall switch which allows separate use of heater, light and fan. 1320 watts, 4500 Btu, 175 cfm. Surface mounted unit, Model BH6-S, is a radiant heater and extends 7⅝-ins. from the ceiling. Unit mounts to any standard 3 or 4-in. junction box and has an all-chrome grill. 1000 watts, 3400 Btu. Recessed heater Model BH6 is a fan forced unit that mounts flush with the ceiling and includes an automatic overheat safety switch. 1250 watts, 4300 Btu.

Berns Air King Corp., 3050 North Rockwell St., Chicago 18, Ill.

Control **(56)**

A new light energized tubeless control with self contained head using a cadmium cell as the light sensing element. The cell is mounted behind a shield 2 ins. from the lens with only a small opening between cell and lens. Control relay contacts are SPDT, silver cadmium oxide, rated 4 amps at 115 volts ac, non-inductive load. Control is enclosed in a cast aluminum case with dust tight gasket seal tapped for ½ in. conduit. The ¾ in. diameter lens is mounted in flexible neoprene. Adjustable bracket facilitates mounting and alignment of control with the light source.

Autotron, Inc., Danville, Ill.

Product Briefs

(57) A new, cool-operating **ballast** for two 40-watt, rapid start fluorescent lamps has been placed on the market by Sola Electric Co., Chicago, Ill. . . . (58) Lima Electric Motor Co., Inc., Lima, Ohio, has announced the addition of vertical **gearmotors** to their line. Units are available with either flanged mounting face, or with standard vertical extended housing.

(59) Rectifier **battery chargers** manufactured by Syntron Company, Homer City, Pa., regularly available with selenium rectifiers only, are now improved to include the choice of silicon rectifiers as well. . . . (60) 15,000 hour long life **slimline fluorescents** for home and commercial use have been announced by Suclar Laboratories, Newark, N. J.

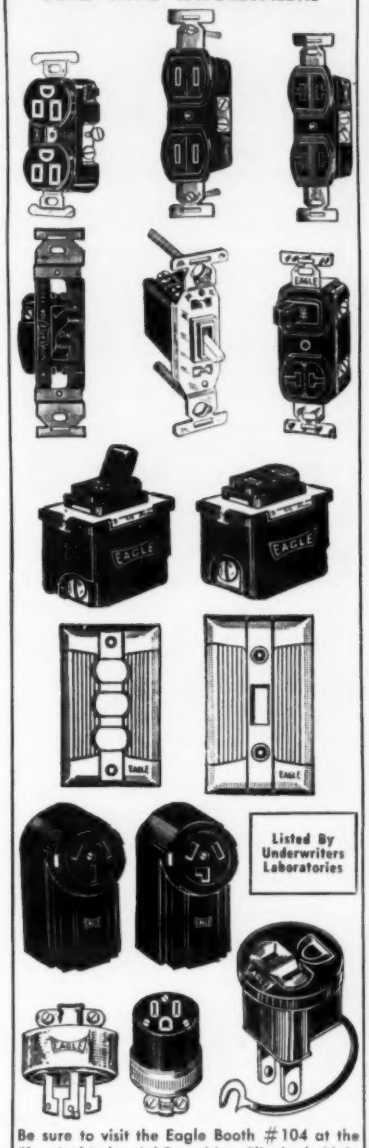
(61) A new fast-curing electrical **insulating varnish,** particularly adaptable to conveyorized baking systems, has been announced by Irvington Division, Minnesota Mining and Manufacturing Co., St. Paul, Minn. . . . (62) Boulin Instrument Corp., Pelham, N. Y., has added to their line a centrifugal hand **tachometer,** known as Tri-Tach.

FOR *ALL* YOUR JOBS YOU DESERVE THE BEST

• EASY WIRING
• TROUBLE-FREE

EAGLE EXTRA QUALITY WIRING DEVICES AT NO EXTRA COST

SOLD THRU WHOLESALERS



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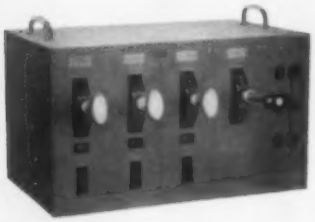
MODERN LOW COST LIGHTING CONTROLS

Ward Leonard now offers famed high quality line of modern dimmers packaged for smaller installations



CONTROLETTE*

Here's a miniaturized version of Ward Leonard's world famous CONTROLITE* dimmer bank.

Designed for churches, schools, restaurants, small theaters and TV studios, the modern CONTROLETTE "package" provides smooth, accurate control of light intensity from full bright to blackout.

CONTROLETTE is available with 3, 4, 5 and 6 individual 2.5 KW VARISTAT* lighting controls which can be interlocked for master control . . . or disengaged for individual control by a simple turn of the master lever. This modern packaged lighting control unit is compact, portable, low in cost, and easy to install.

*Registered Trade Mark

NON-INTERLOCKING LIGHTING CONTROL

This inexpensive lighting control line is designed for reception rooms, building entrances, dining rooms, and other small areas where simple, smooth, flickerless control is all that is required.

These non-interlocking units feature highly efficient, continuously adjustable VARISTAT or RADIASTAT* Dimmers in four standard ratings: 1.2, 2.5, 6.6 and 8 KW. They are designed for incandescent or (with accessories) fluorescent lamp control. Open assemblies or metal enclosures. Hand wheel or slot-closing lever operation. Multiple assemblies up to three units. B.29

For complete facts request: *CONTROLETTE Bulletin 76 P; Non-Interlocking circular 76N from Ward Leonard Electric Co., 28 South Street, Mount Vernon, N.Y.*

WARD LEONARD ELECTRIC CO.
MOUNT VERNON, NEW YORK
Result-Engineered Controls Since 1892
RESISTORS • RHEOSTATS • RELAYS • CONTROL DEVICES

Catalogs & Bulletins

(63) REGULATOR with 60 fingers for direct control of voltage of main fields of large alternators and generators; line load regulation; power amplification; impedance matching; and system stabilization. Basic types and available variations, circuitry, and typical applications are described. Bulletin No. 6.04. 6 pages. Electric Regulator Corp.

(64) STORAGE BATTERIES. Heavy-duty nickel cadmium units for industrial engine starting and standby power applications. Detailed selection data; installation diagrams. Bulletin 200, 4 pages. NICAD Div., Gould-National Batteries, Inc.

(65) TROLLEY BUSWAY industrial electrification system, 100 amps. Bulletin No. 75, 44 pages, describes track, trolleys and accessories used in electrification of cranes and hoists, assembly and production lines, moving test lines, portable and machine tools, aircraft hangars, and other powered moving equipment. Feedrail Corp.

(66) REMOTE-CONTROL SWITCHING manual for electricians, 22 pages. Manual RM-605 describes entire line of Remcon wiring devices. Pyramid Instrument Corp.

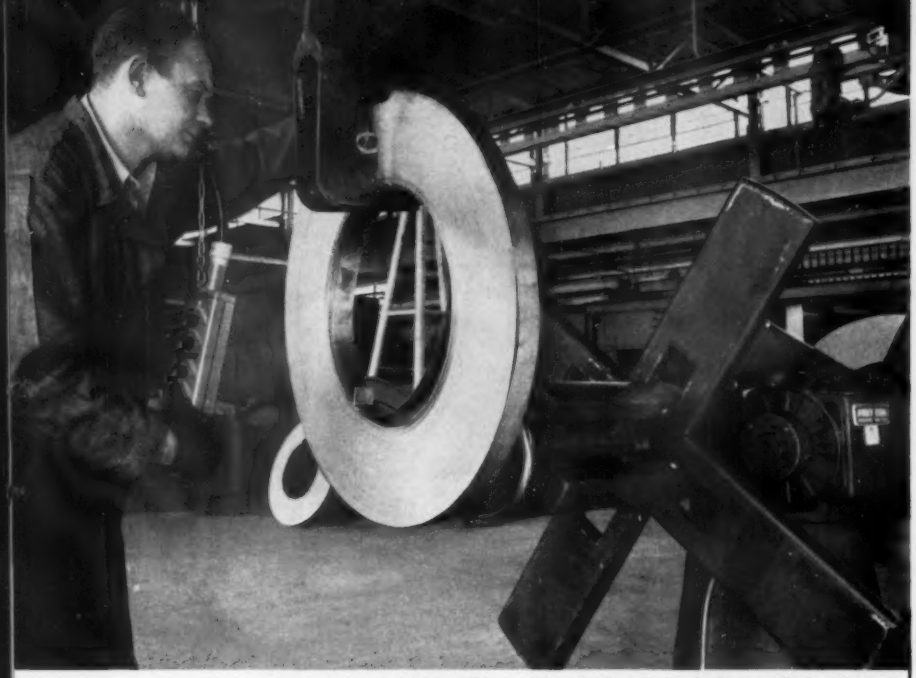
(67) INDUSTRIAL SWITCHES. 20-page Catalog 83c gives complete details of nine housing groups of metal-enclosed switches for industrial uses, including explosion-proof, maintained-contact, prewired, hand-operated and sealed switches. Micro Switch.

(68) MERCURY PLUNGER RELAYS. Engineers' Fact File includes load ratings, contact data, coil characteristics, mounting dimensions, diagrams, and technical articles. Ebert Electronics Corp.

(69) METAL-CLAD SWITCHGEAR. Construction and design features of 4.16-kv horizontal drawout equipment with Ruptair circuit breaker. Bulletin 18B6346C. Allis-Chalmers Mfg. Co.

(70) ELECTRIC METALLIC TUBING. Bulletin EMT-958 illustrates and describes Dualbrite EMT, with tables listing sizes, diameters, weights and data on 45- and 90-degree elbows. Walker Brothers.

(71) INCANDESCENT FIXTURES. luxury line, 24-page brochure covers traditional, contemporary and transitional designs for resi-



Here operator loads pay-off arm with a fresh coil of selected, precisely slit steel.

easier-working CIRTUBE* EMT begins right here with the finest steel!

All the care in the world can't make the kind of EMT contractors like working with — unless the steel's right in the first place.

New CIRTUBE EMT is made with the right kind of steel: specially selected, cold rolled, uniform in quality — and with just the right amount of carbon content for ideal working qualities.

But the right steel isn't enough — proper processing is needed, too. Circle's modern processes are designed to keep in the natural bendability of the high grade steels it selects to make CIRTUBE EMT. Result: tubing that can take it with just the right amount of workability.

Proper steel is only one of many reasons why new CIRTUBE EMT helps get faster, better looking wiring jobs.

Next time you order, try new CIRTUBE EMT — you'll like working with it. Now at your Circle wholesaler's.

*Trade Mark

CIRCLE WIRE & CABLE
a subsidiary of
CERRO DE PASCO CORPORATION

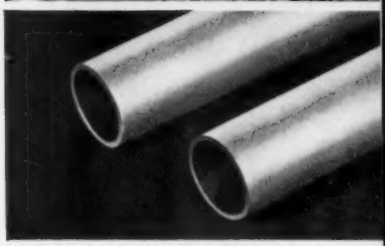
PLANTS: Maspeth and Hicksville, N. Y. **SALES OFFICES & WAREHOUSES:** In all principal cities

RUBBER COVERED WIRES & CABLES • VARNISHED CAMBRIC CABLES • PLASTIC INSULATED CABLES
NEOPRENE SHEATHED CABLES • "CIRTUBE" EMT

CIRTUBE EMT *Ask for it!*

Split-free, bead-free! Induction welded CIRTUBE EMT, left, proves stronger than ordinary EMT, provides easier fishing.

Easy fishing! A baked-on protective coating gives CIRTUBE EMT a built in lubrication for easier wire pulling.

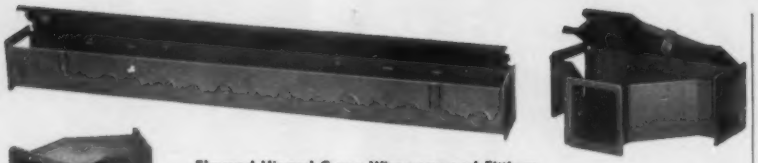


Lifetime exterior finish! Hard galvanized finish for durability; polished satin lustre for lasting good looks.

Automated quality control! Automatic controls assure complete and continuing uniform quality of product.

Tight, easily handled bundles! Bright, orange tapes hold CIRTUBE EMT securely for easy handling on and off the job.

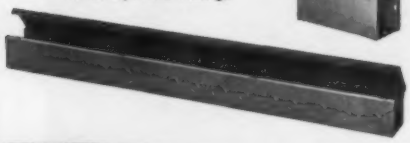
Fast, friendly service! Well-known Circle service through a nation-wide network of well stocked nearby warehouses.



Flanged Hinged-Cover Wireways and Fittings

Flangeless Screw-Cover Lay-in Wireways and Fittings

Flangeless Hinged-Cover Lay-in Wireways and Fittings



It pays to figure on

KEYSTONE

wiring installation equipment

You name it—Keystone has it! Here's the most complete line of quality wiring installation equipment available — anywhere! All sizes, shapes and types of U.L. listed wireways and auxiliary fittings, cabinets, boxes and enclosures—all easy to install and maintain, too. What's more, when you're faced with a special job that "standards" just can't handle—then Keystone will quickly provide custom enclosures to meet your exact needs!

In addition, you'll save time when you specify Keystone — because coast-to-coast regional warehouses assure you of getting *what* you want, *when* and *where* you want it!

Type SC and FC Screw-Cover Pull Boxes

Type A Hinged-Cover Surface Cutout Boxes

Single and Double Door Current Transformer Cabinets

Type PF and PS Telephone Cabinets

3 NEW CATALOGS—Contain complete information on the entire Keystone quality line. Send for your free set today!

KEYSTONE MANUFACTURING COMPANY
23338 Sherwood Avenue • Warren, Michigan

dences, executive offices, etc. Jay Lighting Mfg. Co.

(72) BUTTON CELL BATTERIES. 4-page brochure highlights features and design potentials of nickel cadmium line from 100 to 1750 mah capacities, rechargeable and hermetically sealed. Alkaline Battery Div., Gulton Industries.

(73) LIGHTING FIXTURES and accessories. Catalog M-164 features chandeliers, pole lights, weatherproof convenience outlets in outdoor lantern posts, and many new hanging and recessed residential units. Thomas Industries Inc.

(74) SURFACE HEATING selector guide. Bulletin GEA-6146B, 4 pages, shows how to select heating equipment and controls-type of heater, ratings, heat-up time for metallic platens, material heat absorption, platen heat loss in kw, and other tables. General Electric Co.

(75) TRANSFORMERS. New catalog contains complete engineering information on entire line of dry and liquid-filled transformers. Marcus Transformer Co., Inc.

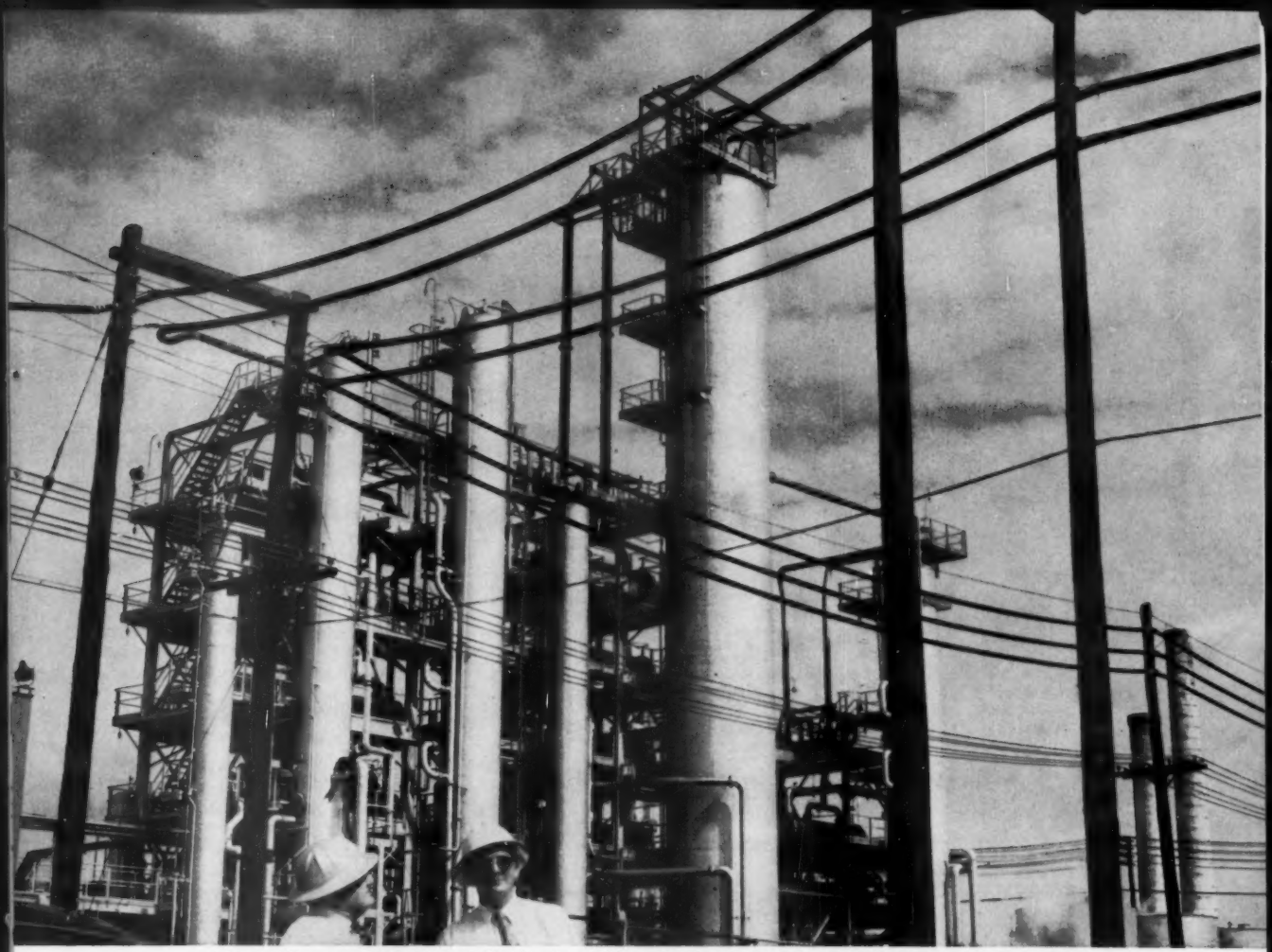
(76) LIGHTING FIXTURES. Waferlume series of extremely shallow fixtures for offices, stores, hospitals and remodelling installations are described in new brochure. Litecontrol Corp.

(77) TIME SWITCHES for automatic control of heating systems. Drawings show in detail how to wire a time switch into a thermostat-controlled circuit. International Register Co.

(78) MAGNETIC STARTERS in NEMA sizes 0 through 4 for both reversing and non-reversing single phase and squirrel cage motors. Bulletin EN-150 describes component units plus magnet coils, overload relays, contacts and enclosures. 15 pages. Cutler-Hammer Inc.

(79) MODERNIZATION IDEAS. 59 product descriptions for modernizing in '59; Booklet 25B9084 covers products ranging from circuit breakers to substations which will improve operating efficiency, increase production, reduce maintenance, and improve working conditions. Allis-Chalmers Mfg. Co.

(80) CONTROL PANEL ACCESSORIES. 4-page Bulletin 104 covers five accessories for use with control panel information systems, including liquid level indicators, interlock receptacles, mercury pushbutton and selector switches, plug-in relay testers, and mechanical pushbutton switches. Panellit, Inc.



Okonex-Okoprene 15kv primary distribution cables solve Magnolia Petroleum Company's space problem and climate problem (wet and salty atmosphere) and provide greater safety in its Beaumont refinery.

Magnolia Refinery improves voltage regulation, beats humidity with Okonex-Okoprene cables

The giant 1,500-acre Magnolia Petroleum Company refinery, located on the broad Gulf Coast Plain, generates and uses 900,000 kilowatt hours a day, more than its neighboring city of Beaumont, Texas. A cable breakdown here could cause costly damage to equipment and the material in process (more than 400 oil products are manufactured). The entire cable system must serve Magnolia's round-the-clock operation without interruption in the face of the high moisture-saline content of the air, plus the chemicals and intense heat used at many of the processing units.

For the 15kv primary aerial loop distribution system, Magnolia's engineers selected shielded Okonex-Okoprene cables. These butyl-base insulated, neoprene-sheathed constructions saved space, eliminated safety problems and provided improved voltage regulation far superior to previous open wire constructions and other insulated cable constructions studied. In addition, their excellent moisture, heat and corrosion resistance were important assurances of maximum service life.

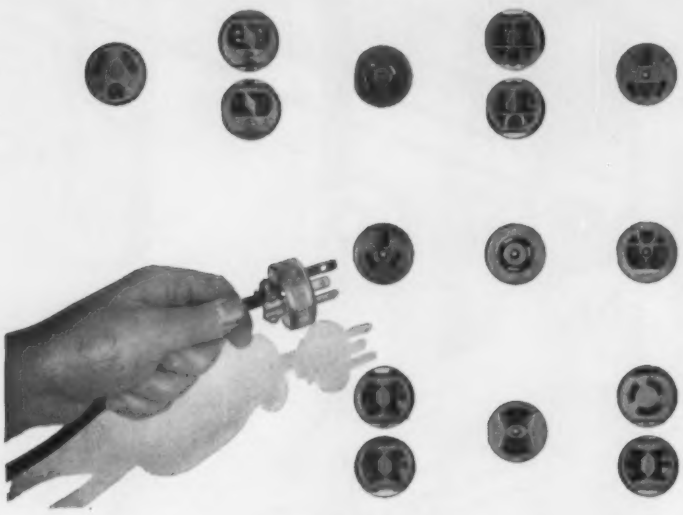
Okonex-Okoprene, in 3,000 to 15,000 volt constructions, was also used for trunk feeders to and from substations, tie lines and motor leads installed both aerially and underground.

To help you specify the optimum cable for your important power and control cable needs, contact your Okonite representative or write for the free Bulletin EC-1117, "How to choose insulated cable," to The Okonite Company, Passaic, New Jersey.

where there's electrical power . . . there's **OKONITE CABLE**

6339

INDIVIDUAL PROTECTION STATIONS



SAFELETS

now available with a wide variety of receptacles and circuit breaker ratings

The Heinemann Safelet is a compact unit that neatly combines circuit-breaker safety with plug-in convenience. It has hundreds of applications, can be used for the individual protection of power tools, fractional horsepower motors and almost all general appliances.

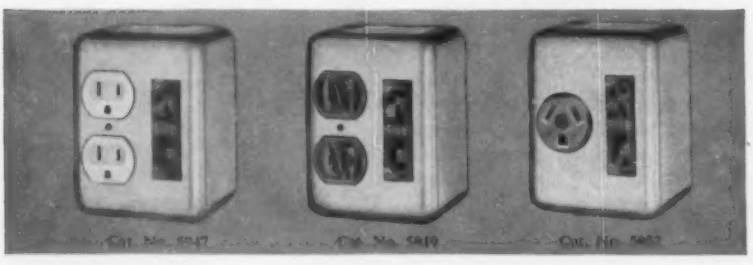
Now you can have the Safelet with any of a large number of receptacles, single and duplex, in twist-lock, polarized, "T" slot and other styles.

And now you can have a wide choice of circuit breaker ratings: from 6 to 50 amperes, at the most commonly used a-c and d-c voltages.

The Safelet enclosure is made of 16-gauge steel with an attractive grey hammertone finish. Units are available for either flush or surface mounting.

Of course, the circuit breakers used are Heinemann breakers . . . long accepted by the electrical industry as the standard of performance.

For full details, send for Bulletin 1000.



HEINEMANN

ELECTRIC COMPANY

132 Plum Street Trenton 2, N. J.

P.B. 1000

(81) RANGE HOODS and ventilators. 12-page catalog describes in full color new Slim-Trim lines with complete specifications, dimensions, and graphic typical installations. Fasco Industries, Inc.

(82) FIRE ALARM SYSTEM for schools which includes automatic fire department summons, trouble detection, heat-actuated alarm devices, coded alarm signals, automatic reset, plus boxes, alarm bells and horns, all illustrated and described in new folder. Autocall Co.

(83) LIGHTING FIXTURES. Description of eight outstanding lighting installations including skyscraper floodlighting, ship deck lighting, tunnel illumination, racetrack lighting, fountain lighting, illumination of highway toll stations, lighting subway platforms, and interior hospital illumination. 8-page booklet. Simes Co., Inc.

(84) MAGNETIC AMPLIFIERS in 18 standard sizes with power outputs of 500 va to over 32 kva. Bulletin E PD 1296-5 gives full specifications on new Super Power gapless core line. Vickers Inc.

(85) EXPLOSION-PROOF FIXTURES and non-explosion-proof fixtures for hospitals. 12-page catalog covers sealed safety switches and receptacles, explosion-proof feed-in plugs, vented clocks, x-ray illuminators, etc., complete with dimensional drawings and technical data. Appleton Electric Co.

(86) TOGGLE SWITCHES. 8-page Catalog S106 covers ten of the most popular switch series with dimensional outlines, illustrations, and specs. Sargent Electric Corp.

(87) SUPPORT BRACKET for attaching electrical service drop to buildings allowing 360-degree cable approach without holes in roof. New Bulletin 101 gives complete specifications. Powerline Support Co.

(88) LIGHTING FIXTURES and accessories. New Catalog CTC-3 covers two new high bay series, 1000-watt mercury floods, fluorescent floods, RLM reflectors, full-range balanced hinged poles, plus complete standard line. Steber Mfg. Co.

(89) STAGE LIGHTING handbook for architects and engineers. 28-page manual covers planning and designing modern stagelighting for theatres, hotels, schools, and churches. Ariel Davis Mfg. Co.

(90) WIRING DEVICES. New pocket-size catalog covers grounding devices, switches, receptacles, combination devices, and other devices. Eagle Electric Mfg. Co., Inc.

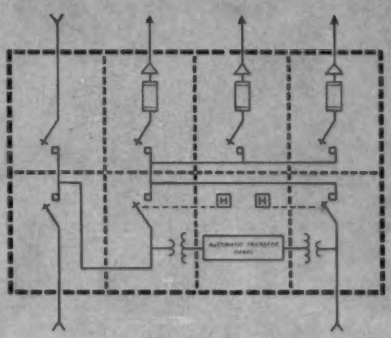
for high voltage service continuity on your critical loads at lower capital outlay— it's S&C Metalclad Switchgear!

To get service continuity on critical loads, you need preferred-to-emergency switching of your alternate incoming high-voltage supply circuits, and short-circuit protection and switching on your outgoing high-voltage supply feeders. All of this can be provided in one low-cost package in S&C Metalclad Switchgear, as illustrated.

You even have built-in choices of throwover schemes through S&C's standard automatic transfer panels.

You save two ways:

1. You get metalclad switchgear with job-matched load interrupters and power fuses, in lieu of costly circuit breakers.
2. You eliminate cost of custom designing by using an off-the-shelf transfer panel with built-in options.



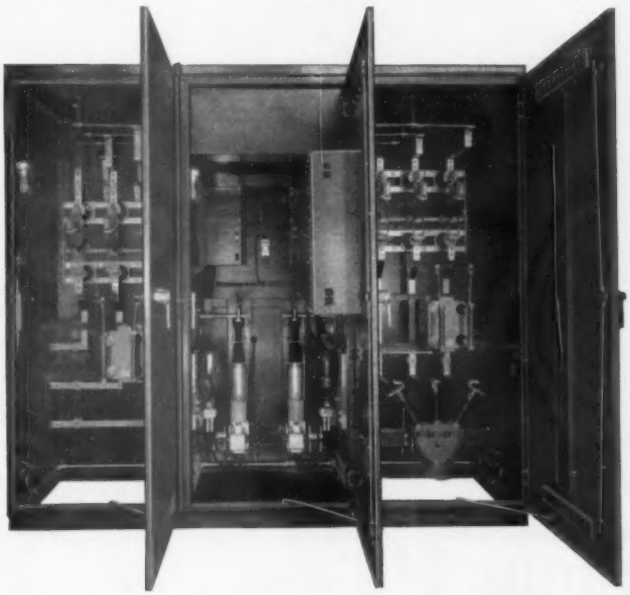
Schematic for 8-bay switching center unit (above) shows throwover control of 2 of 3 alternative incoming sources to provide continuous service for three outgoing feeders.

S&C Standard Automatic Transfer Panel provides for making either source preferred, for automatic or manual return, for adjustable time delays, for choice of returning in either open or closed transition, and for optional lockout on bus faults.

No organic insulation to cause corona trouble; porcelain and air only.

High-Speed Automatic Switching.

Full-length bulkhead doors; rainproof, with complete access.



Super Durabake finish with galvanized and stainless steel hardware; withstands corrosive atmospheres.

Separate compartment for Moto-Draulic operators; free access and decoupling for checkout.

Strip heaters with adequate venting prevents moisture accumulation.

Power Fuses
Tool Operated Disconnects
Open and Enclosed Cutouts
Fuse Links
"Loadbuster"
Load Interrupters
Metalclad Switchgear

S&C ELECTRIC COMPANY

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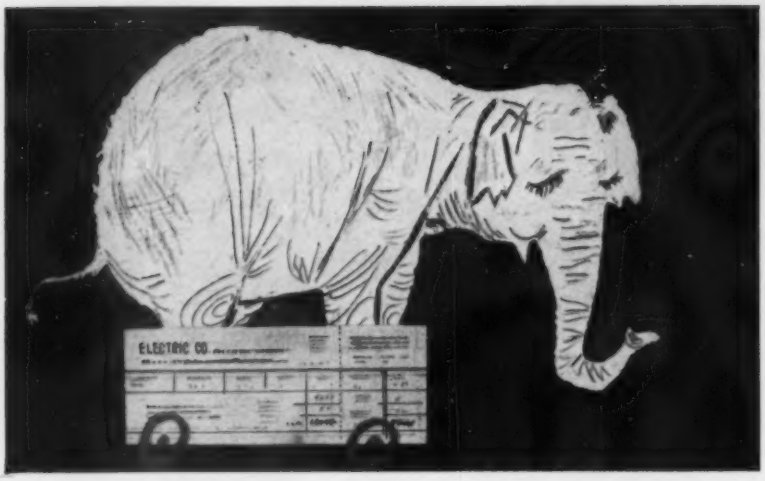
In Canada: S&C Electric Canada, Ltd.
8 Vansco Road, Toronto 14, Ontario



THE ABOMINABLE WHITE ELEPHANT

ON YOUR ELECTRIC BILL

IF YOUR ELECTRICAL SYSTEM is burdened with a low power factor, you're paying for electricity you can't use . . . you're giving up electrical capacity you may need.

The motors and other inductive devices in your plant use both kilowatts (working current) and kilovars (magnetizing current) in order to run. The kilowatts you buy. The kilovars you can best supply yourself. *The more you supply, the higher your power factor, and the less you pay the electric company.*

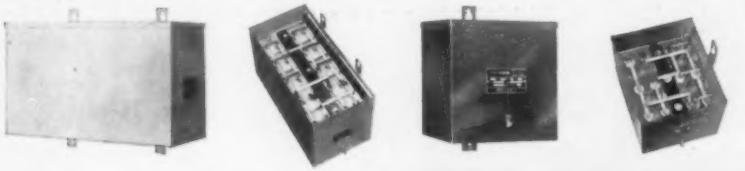
Sprague Unipak* Power Factor Correction Capacitors are the most economical and efficient means of supplying your own kilovars. You put them right where they're needed . . . *at the motors.* Your electric company does not have to send as many kilovars all the way from the power plant, so they charge you less. Your wiring does not have to carry the extra kilovars to the load, so it can handle additional loads.

Actual power bill savings experienced in many plants have more than paid for the Power Factor Capacitors in less than a year's time . . . in some cases, in less than six months. And as an added dividend, these capacitors have also increased the power handling capacity of many plant distribution systems by an average of 20%.

You, too, can reduce costs . . . increase your plant's electrical capacity by installing Sprague Unipak Power Factor Correction Capacitors.

If you'd like *free* assistance in making a survey of your electrical installation to see how *you* can save money with Sprague Unipak* Power Factor Capacitors, write Industrial Capacitor Division, Sprague Electric Company, 333 Marshall Street, North Adams, Massachusetts.

*Trademark



WORLD'S LARGEST
CAPACITOR MANUFACTURER

SPRAGUE®
the mark of reliability

(91) SWITCHES. REVISED 24-page catalog covers high-temperature, maintained contact, explosion-proof, high capacity, proximity, oil-tight, environment-free and multi-circuit precision snap-action and mercury switches. Micro Switch.

(92) PANCAKE MOTOR. Bulletin 2150 presents full engineering information on flange-type motor which reduces motor length up to 54% over standard motors for use on machine tools, roof-ventilating fans, and other space-cramped applications, in ratings from 1 to 15 hp. Louis Allis Co.

(93) CORRIDOR LENS. Bulletin L-120-M covers product data on Lenslite and specular Alzak reflector for providing uniform lighting of extended floor areas and supplemental lighting of adjacent sidewall areas. Corning Glass Works.

(94) VAPORTIGHT FIXTURES. 12-page catalog includes specs and dimensional data on line of interchangeable pendant, ceiling and wall lighting fixtures. Stonco Electric Products Co.

(95) SILICONE BATTERY PLATE. 4-page Bulletin GB-1876 describes process for introducing arsenic and silver cobalt sulphates into active materials of positive plates adding 10 to 25% longer life to storage batteries. Gould-National Batteries, Inc.

(96) EXPLOSION-PROOF EQUIPMENT. 6-page Bulletin 2710 describes design and construction principles involved in manufacturing Condulet electrical equipment for hazardous locations. Crouse-Hinds Co.

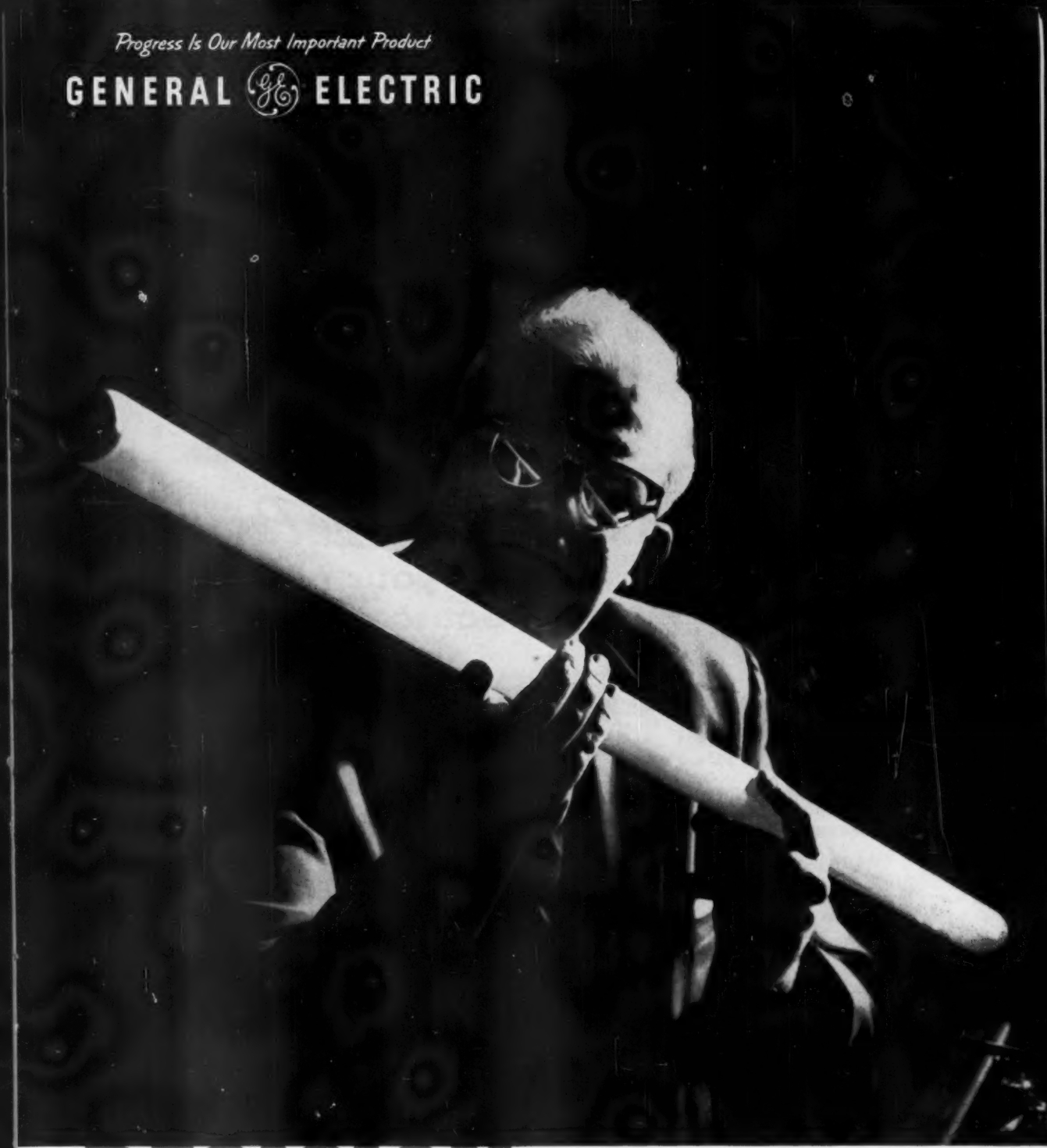
(97) MOTOR FAILURE prediction through periodic insulation tests. Instrument Application Notes, Bulletin 2-60.1, is designed for use by regular maintenance personnel. Associated Research, Inc.

(98) REDUCED VOLTAGE STARTERS for centrifugal compressors, hammer mills, pumps, large conveyors, large fans, m-g sets, and other applications. Line covers ratings from 50 to 1200 hp, 600 volts. Bulletin 14B8192. Allis-Chalmers Mfg. Co.

(99) POWER CABLE Manual, 152 pages, covers basic designs and applications; weights and dimensions; formulas, tables and technical information; recommended installation practices for duct and conduit, direct burial, aerial, splicing and terminating; and drawings and instructions. Okonite Co.

Progress Is Our Most Important Product

GENERAL ELECTRIC



DECISION

"Alone . . . just me and my question . . . which lamps to buy. All look about alike . . . but I keep remembering what past experience has proved to us about General Electric Lamps. That 999 out of 1,000 are sure-starters . . . and 99 out of 100 will still be burning in 1961. And happy thought! We pay less for a case of G-E Fluorescent Lamps today than we did in 1950!"

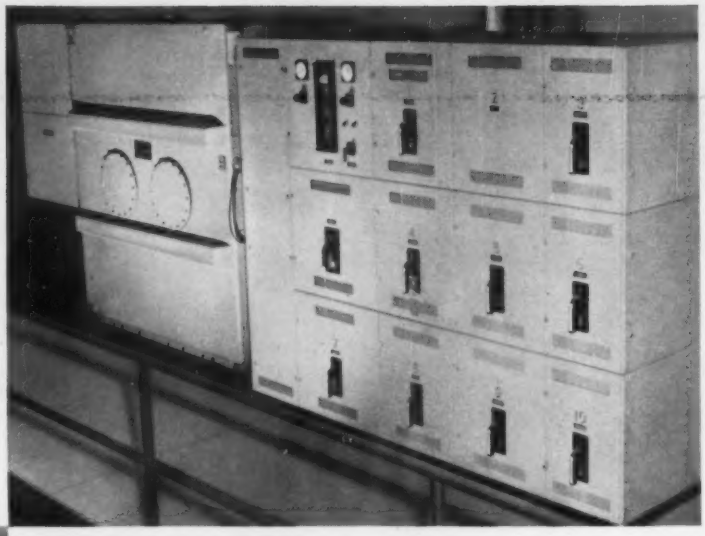
DECISION: "Why gamble on performance when I can get G-E Lamps at little or no premium in the purchase price."

General Electric Co., Large Lamp Dept. C-905, Nela Park, Cleveland 12, O.

Wagner

SEALED DRY-TYPE TRANSFORMERS

These modern unit substation transformers can be safely installed in any load-center—any place—because they are hermetically sealed in welded steel cases to provide positive protection from contamination, fire and explosion hazards. The only maintenance needed is periodic checking of gas pressure (inert nitrogen), case and bushings.



Here's Reliable Power

for your plant electrical system

WAGNER LOAD-CENTER TRANSFORMERS

Wagner

INDOOR DRY-TYPE TRANSFORMERS

These new quiet-type transformers are compact, light in weight, provide a flexible, modern power system to change higher voltage distribution service to lower voltage lighting and power circuits. They meet all safety requirements for indoor installation.

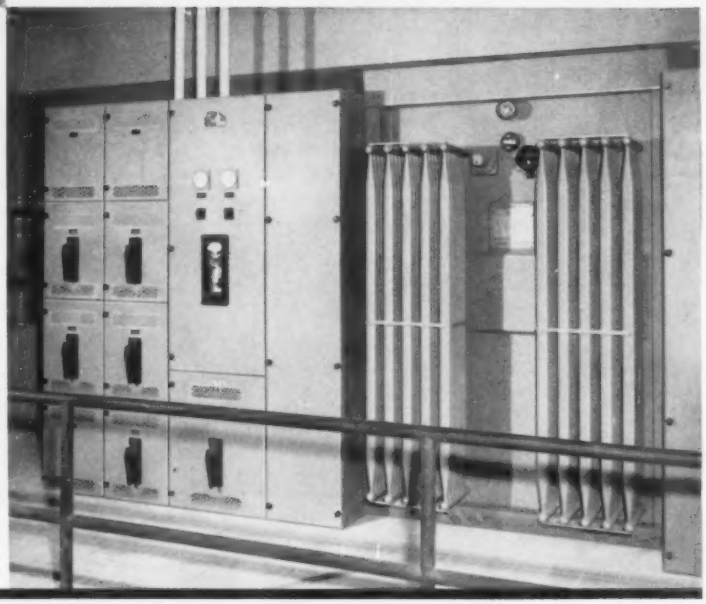
Wagner

NOFLAMOL TRANSFORMERS

Non-inflammable liquid filled. For indoor or outdoor installation. Close-coupled design fits flush against switchgear enclosures, to eliminate and save space. Throat-connected designs are also available.

Bulletins TU-205 and TU-214 give full information on Wagner Load-Center Transformers. Write today.

WT59-2



BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Wagner Electric Corporation

6413 Plymouth Ave., St. Louis 14, Missouri.

SERVING 2 GREAT GROWTH INDUSTRIES . . . *ELECTRICAL . . . AUTOMOTIVE*

Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installations, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Transformer Banks

QUESTION E35—We operate several delta-delta 2400/440-volt transformer banks from our own isolated 2400-volt system. We generate our own power and have no interconnection with any other system. The primary is free of grounds. We make monthly checks on the 440-volt systems to detect grounds. Using a 600-volt ac meter we find there is always a reading to ground from all phases which normally are equal in value. This is normal as there is a so-called phantom neutral under these conditions. Any reading less than normal or a reading of zero volts to ground indicates a ground on that phase and is promptly cleared up.

Recently, however, we found one phase of one bank reading zero to ground while the other two phases read something over the range of the 600-volt scale of the instrument. A burning ground in a control wire was subsequently located and corrected which cleared up the readings, making all three phases equal to ground. This is the first time we have ever encountered this high reading to ground and would like someone to give an explanation.—R.M.K.

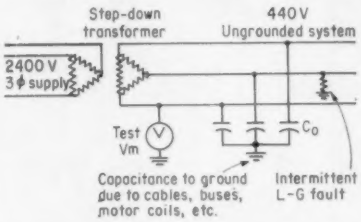
ANSWER TO E35—Your ungrounded neutral distribution system, as all such low voltage systems are, is subject to over-voltages caused by intermittent line-to-ground faults. It is quite common for intermittent ground fault conditions on low-voltage ungrounded neutral systems to create over-voltages of five or six times normal.

In an unusual case of an intermittent ground fault in a motor-starting autotransformer on a 480-volt system, line-to-ground potentials in excess of 1200 volts were measured. In the process of clearing and the restricting of an intermittent ground, a constant dc potential to ground on the system's neutral can be maintained by a charge being trapped on system capacitance to ground. This will cause the phase-to-neutral voltage of the ungrounded phases to exceed the expected 440 volts in your case.

Over-voltages caused by repetitive restrike or intermittent grounds can be eliminated only by system neutral grounding.—B.H.J.

ANSWER TO E35—There are a number of ways in which the line-to-ground voltage on ungrounded ac systems can be caused to exceed the line-to-line voltage. For complete details, refer to Chapter 5 of the Industrial Power Systems Handbook by D. L. Beeman (a McGraw-Hill book).

In your immediate case, I suspect that it was the intermittent sputtering ground fault on one phase which was the culprit. The capacitive coupling to ground (see sketch), an unavoidable property



of an ungrounded system, provides an electrical circuit in which a rapid make-break fault circuit to ground can develop abnormal voltage from line to ground. In extreme cases, voltages of several times the line-to-line value can be so developed.

Incidentally, it is this capacitive reactance coupling to ground which accounts for a voltmeter reading from line to ground when no fault condition exists.—R.H.K.

Thawing Pipes

QUESTION F35—We have a 7½-kva distribution transformer 2300—115/230-volt which we would like to convert into a device for thawing out frozen water lines. From this information, can you tell us what necessary changes would have to be made in the transformer to utilize it for this purpose?—F.D.S.

ANSWER TO F35—Regarding the possibility of converting a distribution transformer into a device for thawing out frozen water lines, the common way in which this is done is by making the transformer into a low-voltage unit and connecting the low voltage ends to the water pipe in question. In a small unit which we built, the output voltage was in the neighborhood of 3 or 4 volts and the output current in the order of 200 amps. From this it will be seen that the 7½-kva unit which the questioner has in mind is suitable for a very much larger application than the one that we built.

However, owing to the fact that this large distribution transformer has a 115-volt winding, this will mean that at the outside something like 75 amps can be obtained in the secondary. This will really be insufficient to do much of a thawing job.

In essence, what is required is a low voltage high current transformer and I do not think that this distribution transformer will be satisfactory. Another point to watch is that some sort of limiting device must be used in the primary to make sure that excessive current is not drawn. In the unit which we constructed for this job, we inserted a heavy duty choke which acted as a current limiter in the primary. This worked very well.

If the questioner wants to rewind the secondary so as to deliver approximately 10 volts instead of the 115/230 volts, then this transformer can be used for pipe thawing provided of course some current limiting device is included in the primary—otherwise I would not suggest using this unit.—H.H.S.

ANSWER TO F35—Normally, distribution transformers are not used to thaw out frozen water lines. Depending upon the physical design of the transformer, it may be converted. This is accomplished by winding a few turns of heavy insulated copper wire (capable of carrying at least 200 amps) around the transformer core and 220 or 440 volts applied to the high voltage winding. You will find that a current transformer is more suited for thawing out frozen water lines.—J.A.M.

ANSWER TO F35—In thawing water pipes the question first is

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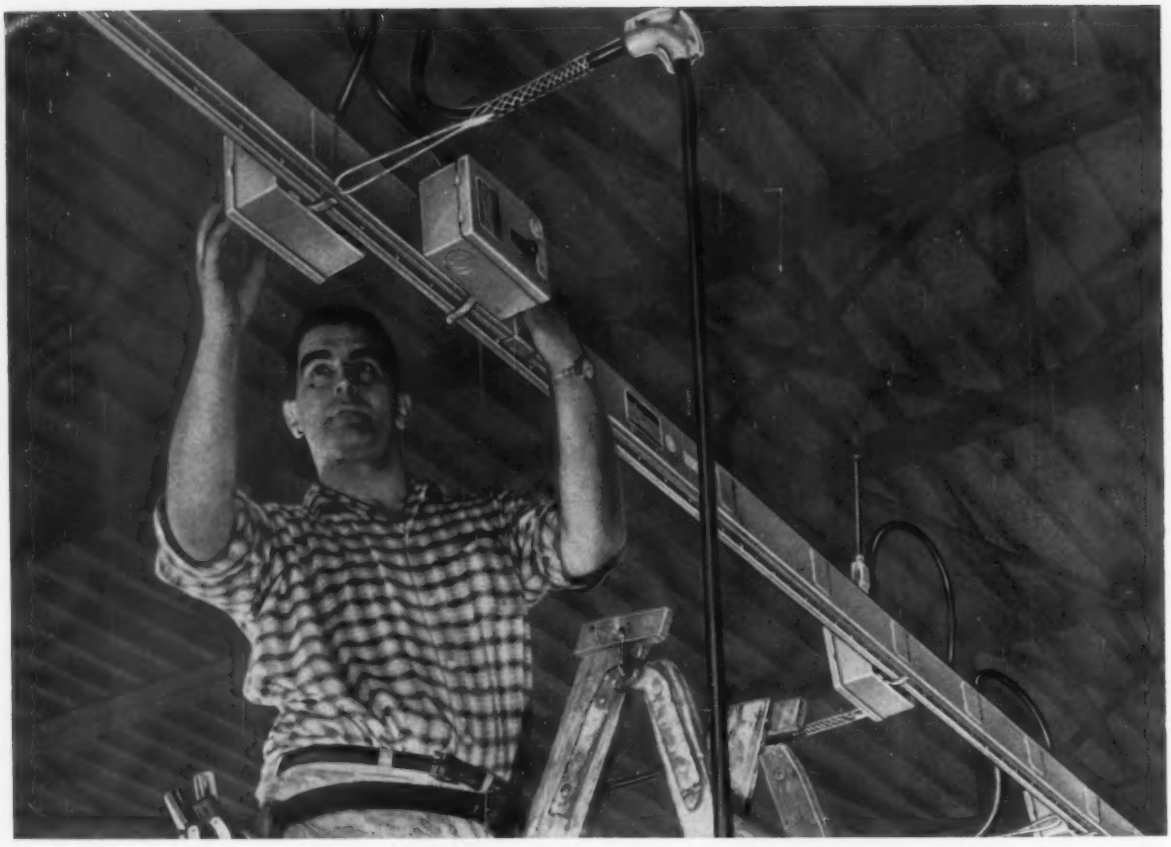

Type DH — rated 100 amperes, 3 wire, single or 3 phase or 4 wire, 3 phase 600 volts maximum—serves as either a feeder or plug-in system and may be used indoors wherever exposed wire and conduit might be applied. It is light, sturdy and small in size (in cross-section not much larger than a pack of king-sized cigarettes).

For the facts about DH, see your G-E representative or distributor. Ask for Bulletin GEA-6172B—or write, wire or phone Distribution Assemblies Dept., General Electric Company, Plainville, Conn.

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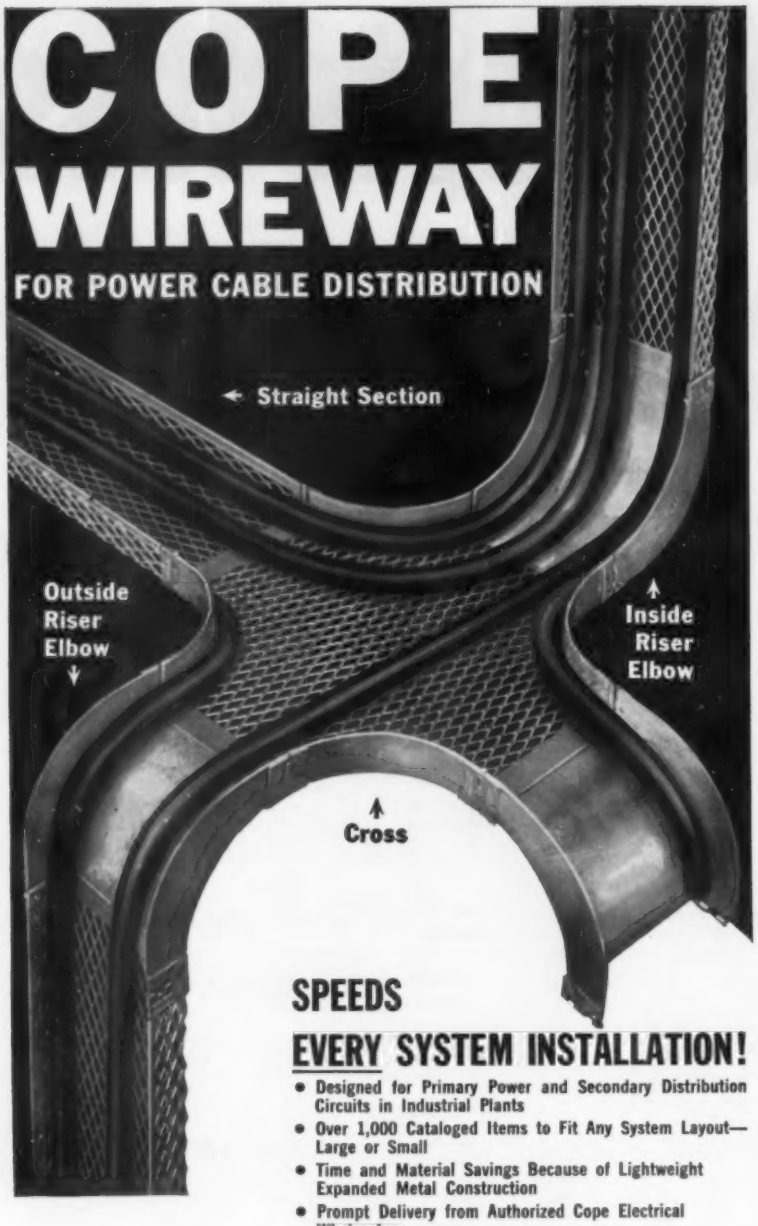

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what size of pipe is to be thawed. To thaw a pipe, current has to be passed through the pipe in excess of its capacity so that heat will be created, and consequently thawing takes place. On small pipes up to 1-in. size, I have used a 300-amp welding machine and for longer distances, I have connected two machines in parallel. For larger size pipes, I have used two 25-kva transformers connecting the primary in series and the secondary in parallel making a very low secondary voltage with high amperage.

Therefore, the primary fuses would hold on a short circuited secondary. I would suggest you try two 7½-kva transformers with primaries in series and secondaries in parallel, wiring the 110 taps on each so the secondary voltage would be around 55 volts. Otherwise, you would have to rewind your present transformer to be able to get the high output current necessary for thawing pipes.—E.H.

ANSWER TO F35 — A 7½-kva, 2300/115/230-volt transformer is not a very satisfactory equipment for thawing pipes. This transformer is rated 65 amps on the 115-volt secondary connection. It will handle for short periods, low ambient temperature and low voltage considerably over 100 amps. This current would probably thaw small pipes at a slow rate.

The application of 230 volts to the 2300-volt winding of a 7½-kva transformer should induce a current of about 100 amps in the secondary when connected to a pipe. In this case the current will depend mostly on the transformer impedance, rather than the pipe resistance. If the transformer has a lower impedance than about 6% it may be necessary to insert a resistor in the primary circuit. This should be rated 1000 watts and adjustable 0-20 ohms. If the impedance is about 3%, 120 volts applied to the primary will be more satisfactory.

If a small ac welder is available a higher current could be produced with less waste of kva rating.—C.H.S.

Insulating Material

QUESTION G35—Does the dielectric strength of an insulator vary with its insulation resistance or is it independent of the insulation resistance and why? How does variation of insulation resistance due to current flow caused by voltage affect the dielectric strength?—E.B.

ANSWER TO G35—Dielectric strength is independent of insulation resistance. By definition, dielectric strength of an insulating material is the maximum potential gradient that the material can withstand without rupture (ASA). For practical purposes, it is obtained by dividing the breakdown voltage by the thickness of the material between the test electrodes and is a destructive test. On the other hand, insulation resistance is the measure of leakage current through the body of the material and is most conveniently measured with a Megger. This is a non-destructive test. —J.E.F.

ANSWER TO G35—The value of the insulation resistance, or the quality of opposing the flow of current, is dependent upon the surface dielectric strength and upon the volume dielectric strength of the insulating material. These two dielectrics are in parallel. The breakdown, or point of rupture, varies with numerous factors, such as the rate, frequency, and duration of voltage application; the shape of the electrodes; the thickness of the dielectric material; the chemical reactions; and the humidity.—W.R.S.

Paper Mill Chipper Problem

QUESTION H35—*In the paper mill where I am employed, we have a 200-hp, 900-rpm, 3-phase, 2400-volt slip ring motor which drives our main chipper. Due to speed-ups to meet our competitors' prices, we are overloaded at times as much as 50% on this motor.*

One engineer said to be sure to put in a 400-hp synchronous motor because it will pay for itself quickly by power factor correction and efficiency. Another engineer said it would be best to use a 300-hp slip ring motor because slip ring motors can take overloads more easily and will not give trouble, such as pulling out of phase under heavy loads. He also said the savings would more than purchase capacitors to make up the difference in power factor correction. Who do you think is right and why?—M.D.

ANSWER TO H35—It takes a lot of efficiency and power factor correction to pay for a shutdown during a busy season. If you change the motor, and the chipper can take the power of a 400-hp slip ring motor, then buy a 400-hp slip ring

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motor or another 200-hp slip ring motor plus a jack shaft and have the two motors help each other.

A synchronous motor with enough control will retain a high or leading P.F. both at no load and full load. An automatic clutch can remove some headaches but it cannot get parts or an expert to the job in a hurry. You may have to order capacitors that are based on no-load power factor to go with the slip ring motor if so required by your power company.—H.S.

ANSWER TO H35—The replacement of the motor on the paper mill chipper drive should be made with a motor of the same type as that in present installation. A wound rotor induction motor will handle sudden overloads better than a synchronous motor, due to its ability to change speed. Power factor correction, if desired, may be obtained much more economically by the use of static capacitors. Also, the control for the present motor would probably suffice, with slight revision, for the new motor. Extensive additional controls would be required for a synchronous motor.—C.H.S.

ANSWER TO H35—If M.D. checks closely he will probably find that the 300-hp wound-rotor and control costs about the same at the 400-hp synchronous motor with its control. If power factor is low and can be brought up to at least .90 by the one 400-hp motor, the synchronous motor should be considered. However, application is tricky, as a chipper represents a large inertia load and the WK^2 of both motor and chipper wheel should be checked closely against motor performance. The motor should have a pull-out torque of 250% of rated torque. If the system is small, then M.D. should look toward the wound-rotor motor, as its starting kva is much less than the synchronous motor.—H.R.W.

CODE DISCUSSION on interchangeability of circuit breakers interested Kent Stiner (left) and Lou Hopper, both with Bull Dog Electric Products Co., N. Y. C., at IAEI Eastern Section annual meeting in Monticello, N. Y.

Can You Answer These QUESTIONS

QUESTION S35—I would like to secure information regarding the installation of motor branch circuit wires and control wires in the same conduit. I am referring to a 440-volt, 3-phase, 60-cycle motor installation having the usual "start-stop" control circuit at the same potential. I have been informed that at distances greater than approximately 600 ft the contactor may fail to drop out when the stop button is depressed. What would be the reason for this failure? Would it be possible to circumvent this problem for greater distances by installing the control circuits of several motors in a separate conduit?—O.E.S.

QUESTION T35—In our plant we use 6-8 volt pilot lights on our 220-volt ac control circuits. The voltage to the lamps is reduced by any one of three ways: namely, a resistor or capacitor in series with the lamp, or 220/6-volt transformer.

Can someone suggest the reason for these variations? Which is best and why?—R.E.B.

QUESTION U35—Please explain the difference between dynamic braking and dynamic lowering as used on dc series motors. In the case of dynamic lowering is there an opposing voltage attempting to raise the load on the first controller point? These hoists are 25 hp and equipped with magnetic brakes. In other words, how is low controlled speed accomplished?—J.E.P.

QUESTION V35—I have a problem of roaches in conduit constantly giving trouble eating and breaking down insulation on wiring in conduit. Is there anything we could do here?—H.W.L.

QUESTION W35—Which is more economical and efficient—a motorized small fan at high speed or a large fan at slow speed? Both deliver the same quantity of air at the same velocity. Is there a formula for determining the best size fan speed and number of blades?—E.B.

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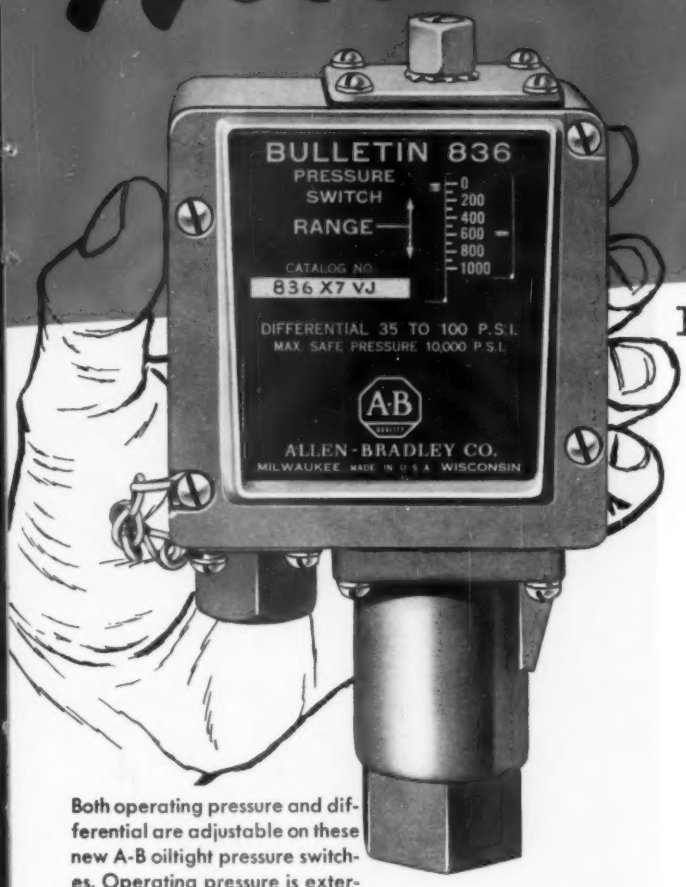

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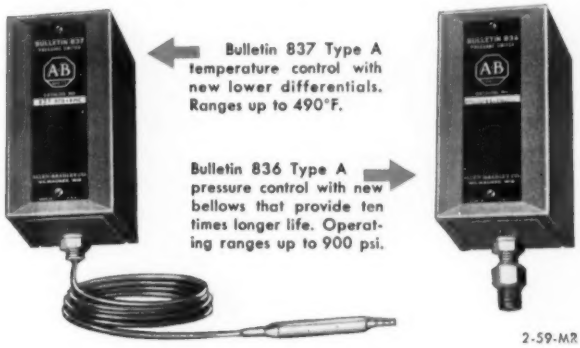

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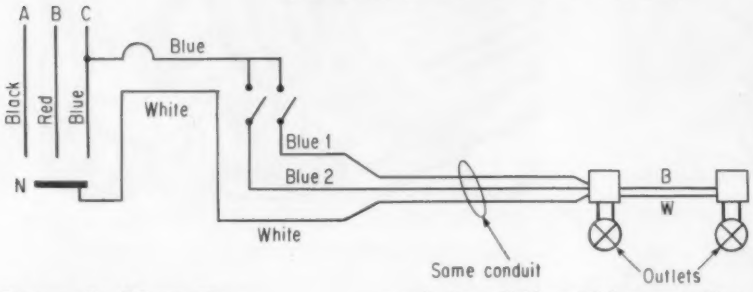
Questions on the Code

Answered by:

B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*



Branch Circuit—Color Code

Q. *In the application shown by the wiring diagram above, does Section 2112 of the code require that both conductors, marked 1 and 2, be of a blue color? It appears that if either 1 or 2 was blue and the other red or black, there would be a question of doubt with respect to the provisions of Section 2112, since the red or black color is associated with the other phase conductors. Would one blue or one yellow be in code agreement? What determines the color sequence when more than one conductor is run in the same conduit and taken off the same phase?—F.D.*

A. For the benefit of our readers, the provisions of Section 2112 reads as follows:

"2112. Color Code. If installed in raceways, as open work, or as concealed knob and tube work, the conductors of multi-wire branch circuits and two-wire branch circuits connected to the same system shall conform to the following color code. Three-wire circuits—one black, one white, one red; four-wire circuits—one black, one white, one red, one blue; five-wire circuits—one black, one white, one red, one blue, one yellow. If more than one multi-wire branch circuit is carried through a single raceway the ungrounded conductors of the additional circuit may be of colors other than those specified. All circuit conductors of the same color shall be connected to the same ungrounded feeder conductor throughout the installation."

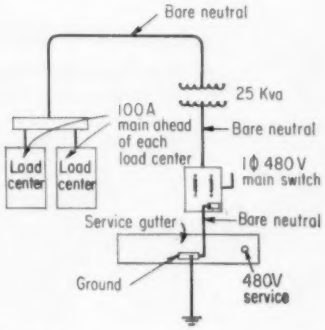
With the advent of the multi-wire branch circuit over 25 years ago, field experience indicated the need for distinguishing one live conductor from another to facilitate a proper balance of the load over the branch circuit. As a result, a few years later a color code was established similar, in some respects, to the one we have today. Strict adherence to this color code also expedites an installation since the occasion for testing is practically eliminated. As in the case presented, when you see a blue covered conductor, anywhere on the branch circuit, you know that it is connected to the "C" phase.

In the case shown by your diagram, it appears that we have a two-wire branch circuit connected to a panelboard which also supplies multi-wire circuits. This circuit terminates in a 2-gang switch enclosure where control of the load served is divided over two switches. From that point we continue to the loads served with three conductors in a conduit, two of which have a blue covering. As a result we cannot distinguish one blue conductor from another without resort to test. It appears evident that the provisions of Section 2112 never intended to cover this situation, and I doubt that the application warrants further complication of a color scheme to satisfy the condition. I believe that the code requires both of the "C" phase conductors to have a blue covering. You could not use a red or black covered conductor in place of one of the blue conductors since they identify the other phases of the system. Yellow appears to be reserved for 5-wire branch circuits and green is reserved for grounding conductors.

In view of the foregoing, it appears to me that the code requires a blue conductor to be used whenever that conductor is connected to the "C" phase, regardless of the fact that both conductors are run in the same raceway. I see no objection however to the use of a tag which would distinguish the two conductors. This question could become quite complicated in the case of 3- and 4-way switch wiring where several conductors of the same color may be in the same raceway. It is also significant to note that the present provisions of Section 2112 recognizes the installation to two multi-wire circuits, with identical color coding, in the same raceway.—B.A.McD.—2/59/1

Bare Neutral

Q. *In the accompanying sketch, bare neutrals are shown extending through the main switch, to the transformer primary and to the secondary load centers. Does this installation comply with the Code?—D.E.F.*



A. The neutral may be a bare wire only in the service conductors. Section 2303a covers the general requirements for the uninsulated or bare neutral where a grounded conductor is installed as part of the service conductors.

In the illustration shown, the grounded conductor (neutral) may be bare in the service raceway shown entering the service gutter at the right, in the service gutter and in the raceway from the service gutter to the single phase, 480-volt main switch. Beyond the main switch the bare neutral, as shown, is prohibited, since this is a feeder and not part of the service.

It should be noted that Section 2303a limits the use of the bare

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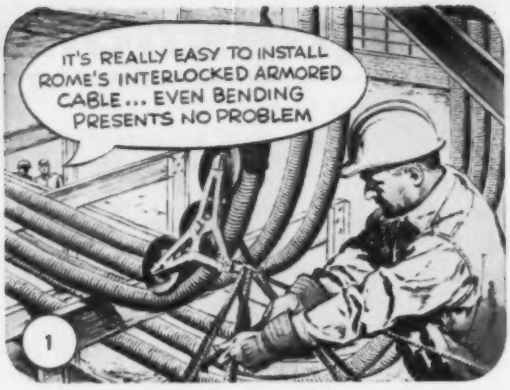

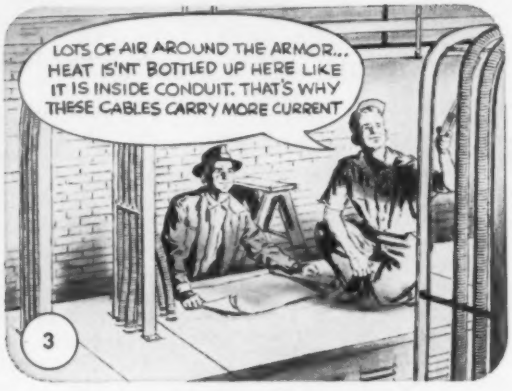
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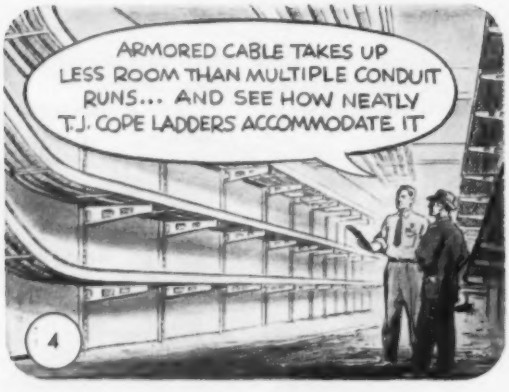

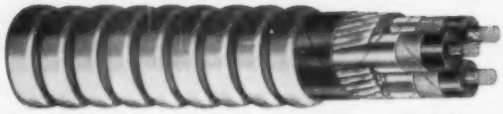

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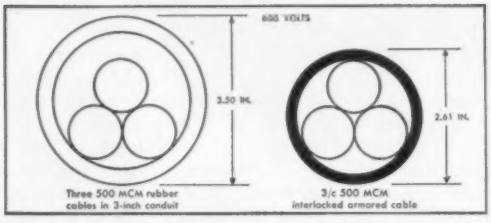

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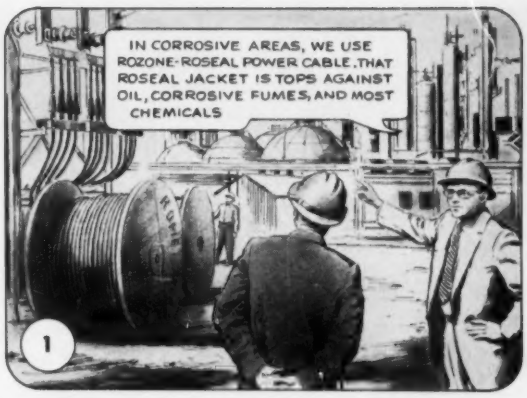
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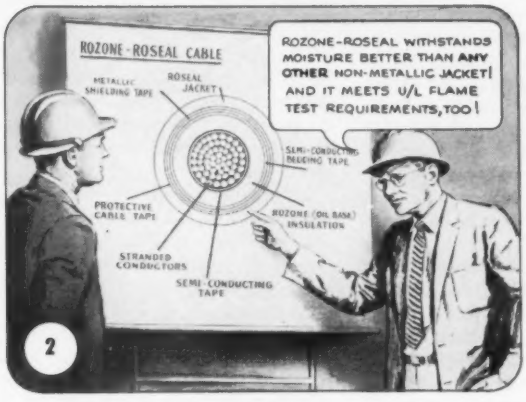

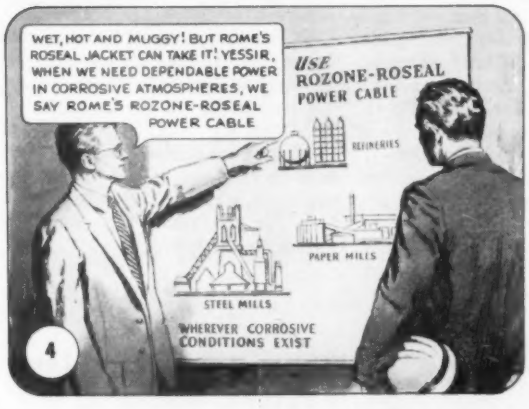
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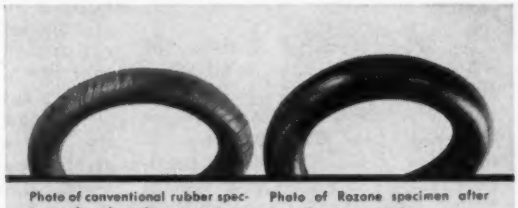

Photo of conventional rubber specimen after short-time ozone test. Photo of Rozone specimen after long-time ozone test.

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neutral to service conductors having a nominal voltage to ground of not more than 300 volts. In the illustration you show a neutral on the 480-volt side so I am assuming this is a 277/480-volt system which of course establishes a voltage to ground, less than this 300-volt value.—B.Z.S.—2/59/2

Protection Against Lightning

Q. *Recently we had a lightning storm which did some damage here in this vicinity.*

What is your theory regarding lightning? I understand it is a controversial subject but the way I understand the common form of lightning is that it goes up into the air with path of least resistance. Could you agree with a statement like this? I don't want to put you on the spot but it is an important question especially regarding insurance adjustment claims, which I have one coming up, and want to give a satisfactory answer to, make the proper installation that would satisfy all concerned. The public should be educated on the subject and any moral support you could give would be most helpful.—H.W.L.

A. The National Bureau of Standards have available a Handbook covering "Code For Protection Against Lightning" which describes the characteristics of lightning discharges. This handbook, known as No. 46, is sponsored by the American Institute of Electrical Engineers, and the National Fire Protection Association. It may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. at a price of 40 cents. As a ready reference on the subject of lightning, this handbook should be in the library of all of us who are concerned with the electrical wiring industry.

The details involved with a lightning flash are described on page 54 as follows:

"It appears that first a "pilot leader stroke" propagates downward at about 100 miles a second from the cloud to the earth. The current in this first pilot streamer is only a few amperes, but it is followed by successive "stepped leaders" which follow the same path with very much greater velocity, each step advancing the tip by a distance of the order of 150 ft. These increase the luminosity and doubtless the electrical conductivity of the stroke channel. These leaders often show numerous branchings and forkings. As soon as one of these leader strokes reaches the earth, the current at the ground end of the path and its luminosity increase enormously and the main stroke propagates upward through the channel already blazed by the leaders. This upward propagating of illumination and of current proceeds at about 20,000 miles a second and develops currents that may become as high as 200,000 amps in extreme cases. This current increases for an interval of 1- to 10-millionths of a second to a high peak value, after which it drops rather more gradually to a lower value, often a few hundred amperes. In many cases, after the lapse of a few hundredths of a second, a second stroke occurs along the same path as the previous main stroke. Such later strokes consist of a fairly rapid "dart leader" followed by a return stroke which is similar to the original and which usually reaches a crest current of the same general order of magnitude. It is presumed that these later strokes are the result of a tapping of additional charged regions within the cloud. Occasionally the later strokes correspond to current of opposite polarity from that in the first stroke because of a contribution from a region in the cloud charged with opposite polarity. As many as 40 component strokes have been observed in a single lightning flash, but most flashes have three or four strokes. —B.A.McD.—2/59/3

CHECKING equipment being moved into their new 40-ft by 160-ft corrugated ribbed steel warehouse building are: (L to R) chief motor winder George Leatherman and partners Russell Booth and Leo Sibert of Sibert-Booth Company Tiffin, Ohio, electric motor repair firm.

50-Amp Branch Circuit

Q. *Does the phrase "or fixed range and water heater" in Section 2126c mean that both may be installed on one 50-amp branch circuit?—B.R.*

A. It is possible to install both on a single branch circuit. To illustrate, suppose we have a water heater rated at 3 kw, 220 volts and a small 7½ kw, 240-volt range. The full rated currents of these units are 12.5 amps and 31.5 amps, respectively. The total connected load is 44 amps.

If we consider the diversity of the loads and the fact that both will not be on simiultaneously for any long period of time (Section 2125b) it is possible to operate both these appliances from this single branch circuit.

It should be noted that Section 4241 requires that each appliance be provided with a disconnect. In the fine print note at the end of 4241a the code recognizes the range and plug receptacle connection as a disconnecting means if this connection is accessible from the front by the removal of a drawer. You would still have to have some sort of disconnect for the water heater.

It is also true that you would have to use the same size wire throughout except where applying the tap rules of Section 2434. If you did not comply with the tap rules and wanted to reduce conductors in size you would have to supply some sort of overcurrent protection for the small tap conductors. —B.Z.S.—2/59/4

Table 1a, Correction Factors, Room Temperatures

Q. *The following question concerns temperature factor correction of current carrying capacity of conductors. The maximum temperature at which a type T conductor may operate is 140° F. The current carrying capacities of Table 1 are based on a temperature of 86° F.*

Then—— 87 *to* 104.....0.82
105 *to* 113.....0.71
114 *to* 122.....0.58
123 *to* 131.....0.41
132 *to* 140.....???

If the maximum operating temperature is 140 degrees F., why is

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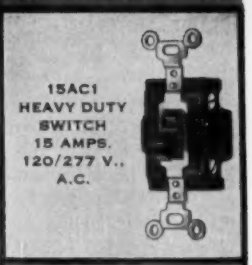
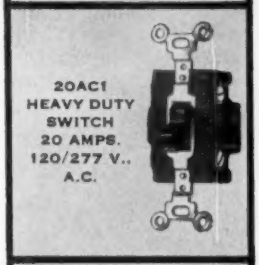
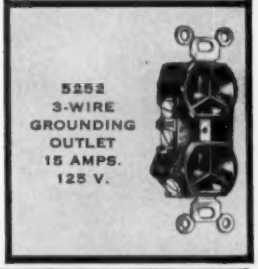


15AC1
HEAVY DUTY
SWITCH
15 AMPS.
120/277 V..
A.C.



20AC1
HEAVY DUTY
SWITCH
20 AMPS.
120/277 V..
A.C.



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the last figure (0.41) *based on* 131 *degrees? For instance, what is the reduction factor for operating the above type T conductor at* 135 *degrees? Realizing the fact that one should never use a Type T conductor at that temperature, (Note 7, following Tables* 1, 1*a*, 2, 2*a*) *a type RH would probably be in order. But the question remains, as a strict interpretation of the code, wouldn't it seem that another percentage should be listed for operation between* 132 *and* 140 *degrees? Then at* 140 *degrees and higher, the multiplier would be zero.—R.C.M.*

A. In order to clarify the question, I have shown by illustration a curve which indicates how the current-carrying capacity of a No. 6 Type T conductor diminishes, from a maximum of 55 amps in a room temperature of 86 F, to zero amperes in a room temperature of 140 F, the maximum temperature to which the conductor insulation may be subjected.

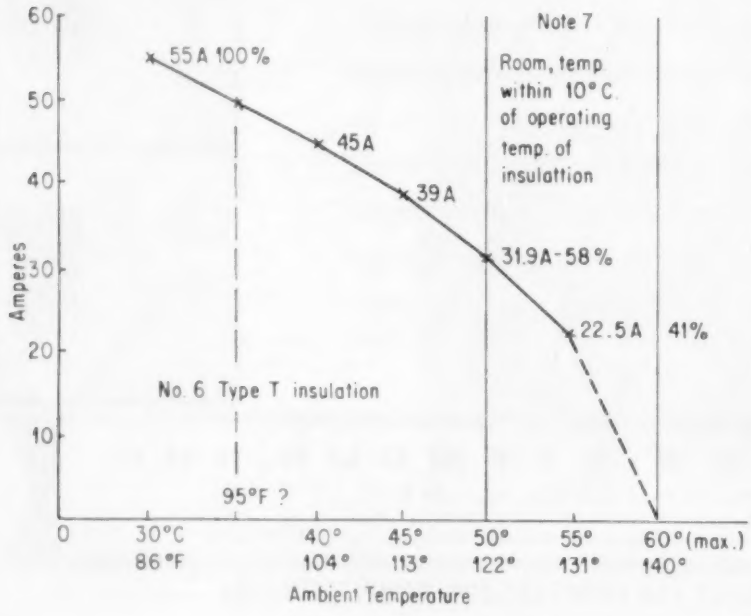
It is quite evident from this curve that the rating established at 131 F exceeds by 5 degrees the recommendation of Note No. 7 which reads as follows:

"If the room temperature is within 10 degrees C of the maximum allowable operating temperature of the insulation, it is desirable to use an insulation with a higher maximum allowable operating temperature; although insulation can be used in a room temperature approaching its maximum allowable operating temperature limit if the current is reduced in accordance with the table of correction factors for different room temperatures."

In view of the foregoing, it appears to me that the code never intended to recognize a derating factor for a 140 F degree rated conductor to be used where the ambient temperature exceeded 131 degrees F. According to the curve, it would appear that a No. 6, Type T conductor operating in an ambient of 135 F could only carry about 10 amps. To me, such an application appears impracticable since a No. 10 RH conductor with a maximum rating of 25 amps would have a current-carrying capacity of 14.5 amps when used in a 140 F degree ambient temperature. Insofar as the code is concerned, I believe the last clause of Note 7 indicates that the T conductor under discussion cannot be used in an ambient which exceeds 131 degrees F.

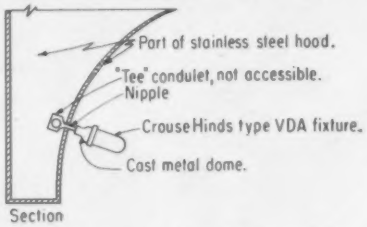
The whole subject of maximum allowable operating temperature for various insulations and ambient temperatures is somewhat complex.

Your question however draws attention to the 18 F degree gap which occurs between the ambient of 86 F and 104 F. In the case illustrated, there is a 10-amp difference in the current-carrying capacity of the conductor. Possibly some consideration should be given to establish a correction factor for a conductor operating in an ambient temperature of 95 degrees F. —B.A.McD.—2/59/5



Wiring Stainless Steel Hood

Q. *A contractor has made an installation of vapor-proof lights on a kitchen range hood as shown by the illustration below. At*



the present time, the fixture wires are spliced to the circuit wires within the "tee" condulet fitting. I have turned this down on the basis that the splice is not accessible. The contractor now proposes to install longer circuit wires and make the splice to the fixture wires within the cast metal dome of the fixture. Can you tell me if this is acceptable, and also answer the following specific question:

It is required that the box called for by Section 3007 *be accessible? —D.J.N.*

A. According to the provisions of Section 3007, a box shall be installed at each outlet, switch or junction point of a conduit system of wiring. There are two exceptions to this rule which are not applicable to the installation in question.

Section 3717 of the code requires junction boxes to be so installed that the wiring contained in them may be rendered accessible without removing any part of the building, sidewalks or pavements. Since the code does not define a "junction box" a question immediately arises concerning the status of this rule with respect to an outlet box or fitting. Abbotts Code Handbook comments as follows:

"As here used, the term junction box may be considered as a covered box used at any point where it is necessary to tap a run of conduit, tubing or cable and where the box is used for this purpose alone, and not as an outlet box."

Section 4149 requires fixtures to be so installed that the connection between the fixture conductors and the circuit conductors may be inspected without requiring the disconnection of any part of the wiring unless the fixture is connected by means of a plug and receptacle. This rule also provides that, "no

unnecessary splices or taps shall be

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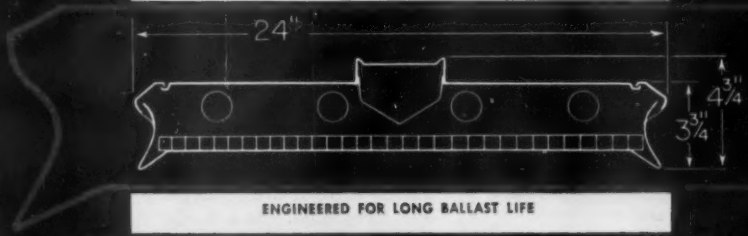

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unnecessary splices or taps shall be made within or on a fixture."

Section 4150 prohibits the use of a fixture as a raceway for circuit conductors unless the fixtures meet the requirements for approved raceways. There is an exception which does not appear to be applicable to the case in question.

According to the definition of accessible (as applied to wiring methods) the condulet in question, which is required by Section 3007, is not involved since it is not permanently closed in by the structure or finish of the building. Ordinarily the splices in such boxes are accessible by removing a cover, a fixture canopy, a switch plate or a receptacle plate. We do however have occasions where access to terminal connections in outlet boxes may be made only by removing the fixture itself. Such procedure is recognized by Section 4179-b covering flush and recessed fixtures. Insofar as the code is concerned, it appears to me that there is no specific requirement for the wiring in an outlet box to be accessible, as definitely required for junction boxes under Section 3717. If such was intended it appears that an appropriate provision should appear under Article 370. The fact remains, however, that Section 4149, which only concerns the connection of the fixture conductors to the circuit conductors, requires such connection to be accessible for inspection. If we consider the entire hood to be a fixture, it appears that this section would not apply to the connection of each individual lighting unit in the hood. I am inclined to believe however that this distorted concept of Section 4149 never was intended to apply to the application in question. If it was accepted, it would be necessary, in case of fault, to remove the steel hood to correct the condition, and I don't believe anyone concerned would sponsor such procedure to clear a minor fault in the condulet or the conduit serving same.

While the contractor's proposal for making the fixture splices within the dome of the fixture may be questionable in view of the provisions of Section 4150, the fact remains that the inspector has the responsibility of deciding if the fixture in question may be used as a raceway for the circuit conductors. This procedure would make it possible to inspect the fixture splices, and in case of fault, the circuit conductors could be removed and replaced without disturbing the stainless steel hood. On a 2-wire branch

circuit, I believe there would be sufficient room to make the splice in the dome of the VDA fixture. While such action could be considered in the case in question, I believe it should be understood that you are not establishing a precedent for future applications until the basis for such action is established with a background of authority.—B.A.McD.—2/59/6

Vent Pipe Hazardous Area

Q. *Is an underground service of RH conductors approved for a service station where the service emerges from the ground* 15 *ft from a tank vent pipe? Section* 5120*b*2. *—H.I.*

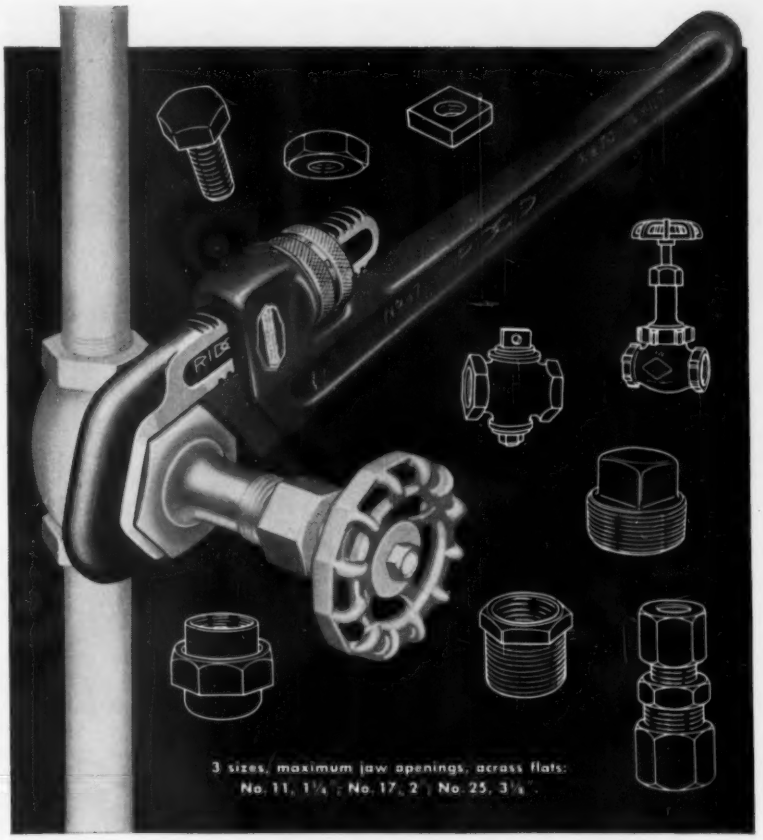
A. The section you refer to defines the Class I, Div. 2 area for a 20-ft horizontal distance all around the vent pipe up to a point of 18 ins. above ground or driveway level. It also states that all the electrical wiring and equipment in this same area but below ground or driveway level shall be classed as Class I, Div. 1 area.

Assuming in your case that the service emerges from the below grade level into the open and then up the side of the building to a point above the 18-in. level, you have your service in a Class I, Div. 1 area (underground), then in a Class I, Div. 2 area (aboveground) and finally in a non-hazardous area.

Section 5023, which is referred to in Section 5120c as governing, requires lead covered cables or other types approved for the purpose. At present the other types approved are the special nylon jacketed types TW conductors. These nylon jacketed Type TW conductors are now being made by some 13 different cable manufacturers.

In your case I would say that the Type RH conductors, unless they are lead covered, would not be approved, since the major portion of the service seems to be within a Class 1 area.

As a point of passing interest I would like to comment on another problem in connection with this vent pipe location. In many installations the upper end of the vent pipe, i.e., the open end at which point the real hazard exists, is at some elevated point above the gasoline tank and very often even above the roof of the service station building. Electrical equipment and wiring are in many cases located



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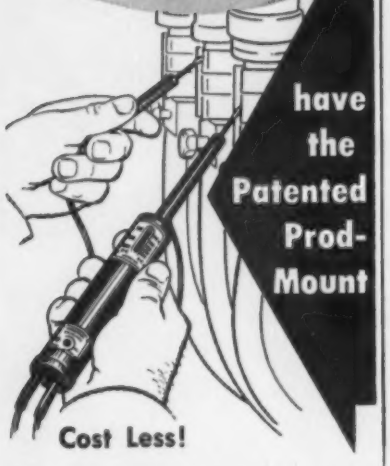

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very close to these elevated vent pipes and are exposed to the vapor and fumes from these pipes.

It is being considered to require that the Class I, Div. 2 classification be applied to the entire area from the upper end of the vent pipe down to ground level. However, instead of an area having a radius of 20 ft horizontally, the hazard would only be considered to exist for a distance of only 5 ft horizontally. In other words a vent pipe extending 25 ft into the air above grade level would in effect have a 10-ft cylindrical area, 25 ft high, classified as Class I, Div. 2 hazardous area.—B.Z.S.—2/59/7

Marine Installations

Q. *I have been doing some work aboard ships. Are there any standards covering such installations?—B.E.*

A. There are several guides that may be used to assist you in making electrical installations on ships. First off I might state that in general all of these supplemental standards, specifications, recommended practices, etc., basically accept the National Electrical Code as their primary standard.

A very comprehensive study of this question has been made by the American Institute of Electrical Engineers through their Committee on Marine Transportation. This study was developed into an excellent report and published as "Recommended Practice for Electric Installations on Shipboard", AIEE No. 45.

The U.S. Navy Department in its Bureau of Yards and Docks Specifications covers the necessary requirements for electrical installations on all its crafts.

It should be noted that many of the electrical fittings manufactured by such companies as the Appleton Co, Crouse-Hinds Co, Pyle National, etc., are acceptable for use on such installations. These are not necessarily labelled as being suitable for such use, but due to their particular acceptance as weather-resistant and weather-proof, many of them have been approved for shipboard installation.

Now as a further help, the Underwriters' Laboratories, Inc., as of July 1, 1958 has begun the listing of "Marine Type Electric Lighting Fixtures". A standard has been issued by them covering these "fixtures", and labelling service is avail-

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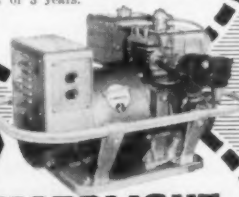

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2. "Inside Watertight type",
3. "Inside Recessed type",
4. "Inside Watertight Recessed type", and
5. "Outside type". — B.Z.S. — 2/59/8

Conductors in Multiple

Q. *Section* 3105 *states that conductors* 1/0 *and larger may be run in multiple. Where in the code does it definitely state that conductors smaller than* 1/0 *shall not be run in multiple?—R.C.M.*

A. As far back as 1923, the code has recognized the use of conductors in multiple. The 1923 provision read as follows:

"610-d. Conductors may be placed in multiple only by permission of the inspection department."

The 1928 *Code* slightly changed the wording as follows:

"612-d. Conductors may be placed in multiple only by permission of the authority enforcing the Code."

The 1937 *Code* re-edited this rule as follows:

"3007. "Conductors may be placed in multiple only by special permis-

ELECTRICAL EXHIBITS on display at Electrical Trade Show held during recent 1958 annual convention of Florida Assn. of Electrical Contractors in West Palm Beach were a main attraction for all FAEC members. Shown here (l to r) are Ed Etheridge, Jacksonville representative for Radiant Electric Heat Co.; James Dandelake, Miller Elec. Co., Jacksonville; Virgil Beery, Pres., Radiant Electric Heat Co., Springeld, Ill.; and Mr. & Mrs. Howard L. Palmer, Palmer Electric Co., Orlando. Messrs. Dandelake and Palmer are both past-presidents of the FAEC group.

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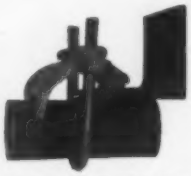

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sion, except as permitted in Section 3052." This exception covered a condition where it would be impracticable to run all conductors in one enclosure. It is similar to the provisions of Section 3018 of the 1956 Code.

The 1940 Code revised the rule to read as follows:

"3008. Conductors may be placed in multiple only by special permission, except as permitted in Section 3052 and 6205. Where conductors are placed in multiple the conductors shall be joined together, both mechanically and electrically, at the terminals."

Section 6205 concerns elevators and recognizes the use of two or more No. 16 conductors in parallel in traveling cables and on the car for the purpose of serving lighting circuits.

The 1946 *version of the Code* read as follows:

"Section 3103. Conductors in sizes 1/0 to 500,000 cm, inclusive, may be run in multiple provided they are of the same length and have the same circular-mil area and type of insulation. Not more than three 1/0, four No. 2/0 nor 5 Nos. 3/0 to 500,000 cm conductors, inclusive, may be run in multiple. Except as herein provided, conductors shall be run in multiple only by special permission or as permitted by Section 6205. (Elevators). Where conductors are run in multiple, they shall be arranged and terminated at both ends in such a manner as to insure equal division of the total current between all conductors that are involved."

The 1953 *version of the Code* read as follows:

"Section 3105—Conductors in sizes 1/0 to 500,000 cm, inclusive, may be run in multiple provided they are of the same length and have the same circular-mil area and type of insulation. Where conductors are run in multiple, they shall be arranged to terminate at both ends in such a manner as to insure equal division of the total current between all conductors that are involved."

The 1956 *version reads* as follows:

"Conductors in sizes 1/0 and larger may be run in multiple provided they are of the same length and have the same circular-mil area and type of insulation. Where conductors are run in multiple, they shall be arranged to terminate at both ends in such a manner to insure equal division of the total current between all conductors that are involved."

A summary of the foregoing his-

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NEW electrical device is shown to electrical contractor W. Alec Brinson (right), of St. Petersburg, Fla. by F. Gross, Sr., Biglin Associates, Coral Gables, while attending the Electrical Trade Show of the Florida Assn. of Electrical Contractors in West Palm Beach recently.

tory of this code rule indicates, during the period from 1923 to 1946, that conductors (may) be placed in multiple (only) by special permission etc. This "may" rule, which indicates permission, is fortified by the word "only" which indicates that the use of multiple conductors is specifically limited to the conditions of use specified at that time. The 1946 through 1956 version of the code deleted the word "only" which indicates to me that applications, other than stipulated may be recognized. This opinion appears to be verified by the fact that both the 1953 and 1956 editions of the code no longer found it necessary to make an exception for elevators which, under Section 6205-a-1 of the 1956 code, recognizes the use of multiple conductors in traveling cables which supply lighting to elevators.

There is no code provision that I know of which says that a conductor smaller than 1/0 shall not be run in multiple. As a result, we have a rule which permits conductors 1/0 and larger to be run in multiple but the status of conductors smaller than 1/0 is not established. Under such circumstances, and in the absence of specific recognition under some other code section, it becomes the responsibility of the authority enforcing the code to interpret the rule, as outlined under the introduction to the code, by the paragraph covering enforcement. I believe that the limitation established by Section 3105 should be followed until some other section of the code sees fit to recognize the use of conductors in multiple smaller than 1/0 for some particular application. — B.A.McD. — 2/59/9

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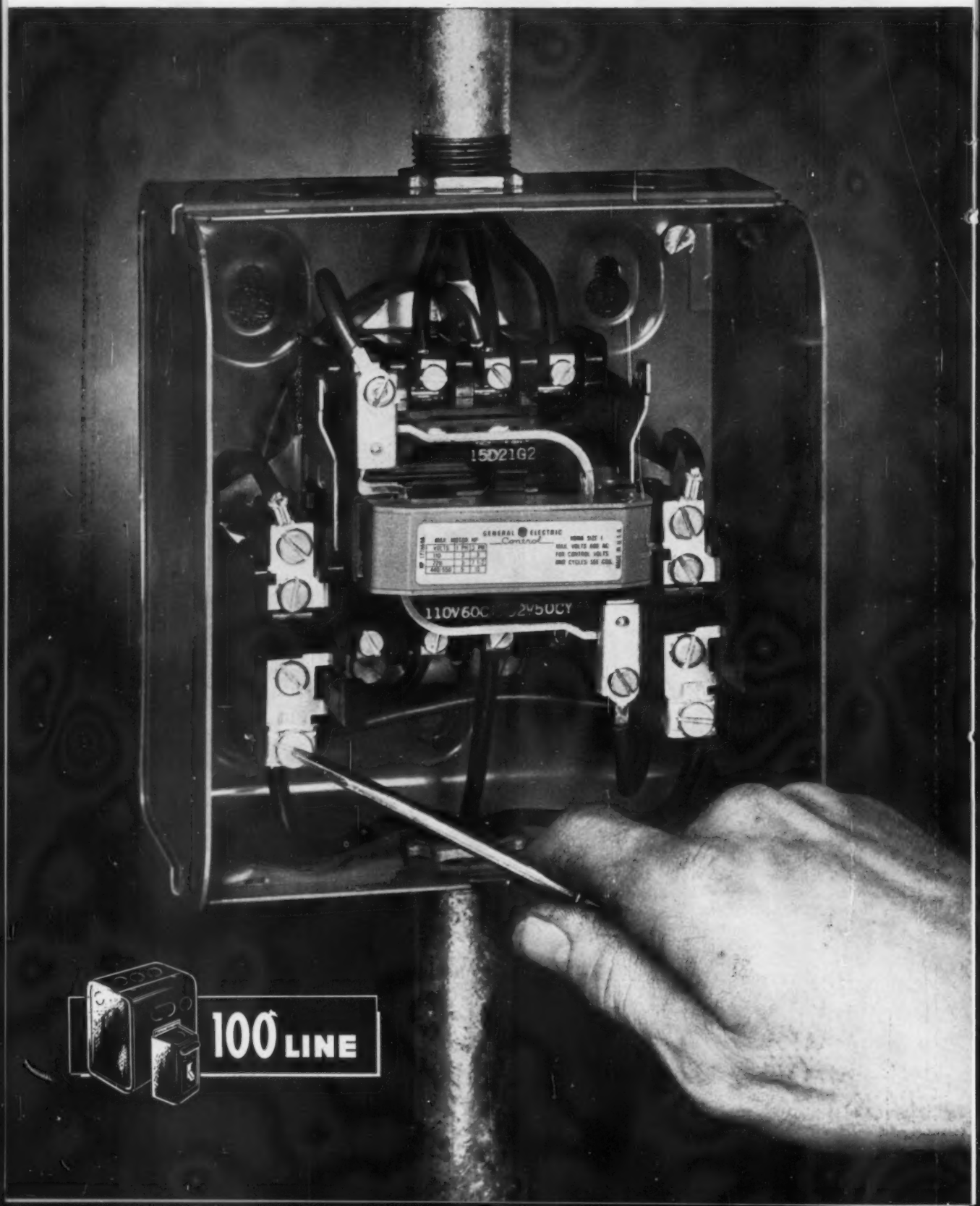

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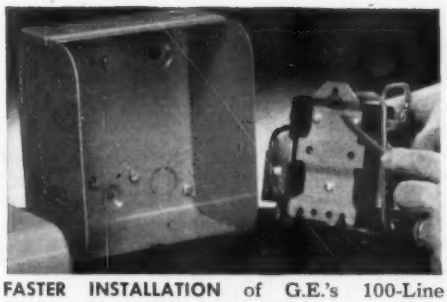

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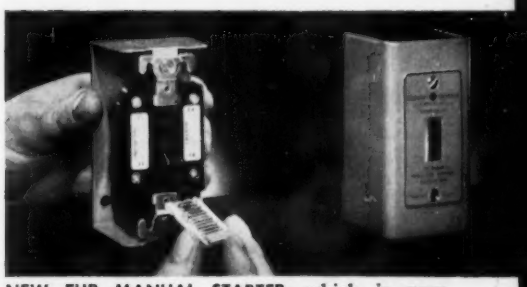

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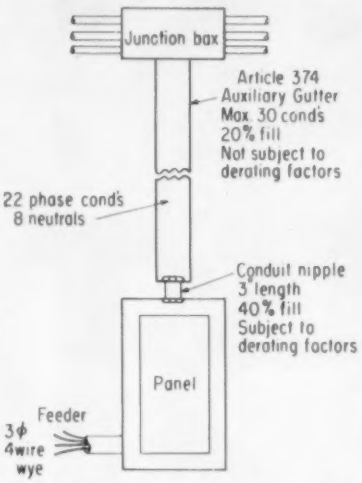
Conduit Fill Short Nipples

Q With reference to the number of conductors permitted in conduit by the various sections of the code, is there any exception made for short nipples extending from auxiliary gutters? I have particular reference to when auxiliary gutters are used in conjunction with panelboards and other equipment. Section 3466-C states that conduit shall not contain more than nine conductors. Where a panel utilizes the auxiliary gutter for passage of branch circuit conductors, the panelboard is very frequently connected to the gutter with a 2-in. nipple and more than nine conductors are run through this nipple even though the percentage fill of the conduit does not present a hazardous condition. Is there any exception to this code requirement in the case of nipples used in conjunction with an auxiliary gutter? It seems that most installations do have more than nine conductors through nipples as it seems it makes a neater appearance than if there were a number of nipples between gutter and panel. Also in cases where there are less than nine conductors in a nipple, is derating of conductors necessary as required by Note 4 following Table 2 A? It does not seem realistic to have to derate an entire circuit just because of the portion that passes through a short nipple; however, I cannot find any exception to the code. Here again, if derating is not wanted a large number of small size nipples would be required between gutter and panelboard which does not make a very neat installation. For example, consider a 42-breaker panel. Theoretically a maximum of 84 conductors could be brought out from the panel if 2-wire circuits were used. If derating is not desired, 42 ½-in conduits (No. 12 wire) would be required. However this is cited only as an example; it can be seen how cumbersome installations would be if compliance with this section were adhered to. As I cannot find any exceptions in the code, I am wondering if I have been violating the code by placing more than nine conductors in nipples.—F.D.

A. According to the provisions of Section 3466-c, one conduit shall not contain more than nine conductors except as noted in Table 9 of Chapter 10. The exceptions do not apply to the application under discussion. When there are more than three conductors in a conduit the current-carrying capacity of such conductors are derated as covered by Note 4 following Tables 1 through 2A of Chapter 10. It is quite possible that the 1959 edition of the code will recognize, for general use, more than nine conductors in a raceway, with appropriate current-carrying derating factors, on the basis of a 40% fill.

In the interests of clarification, I have shown in the illustration an example of the application presented by your question. According to the provisions of Section 3745 an auxiliary gutter shall not contain more than 30 conductors, and the C.S.A. of all contained conductors shall not exceed 20% of the C.S.A. of the gutter. I mention this point since the example cited covers 84 conductors which is in violation of this section. This conductor limitation, on the basis of a 3-phase, 4-wire wye system, would limit the number of overcurrent devices in the panelboard to 22, and in the case of a single-phase, 3-wire system to 20. This statement is based on the assumption that all of the branch circuit conductors from the panelboard are installed in the gutter, and the feeder to the panelboard is in a separate raceway.



The status of a short conduit nipple connecting various enclosures of a metallic raceway system of wiring has in the past been the source of controversy. Many years ago, a water pipe nipple could readily be obtained while manufactured conduit nipples were scarce. As a result, many electricians resorted to the use of water pipe nipples. This practice, I believe, has been discontinued due to the activity of the inspector. An-

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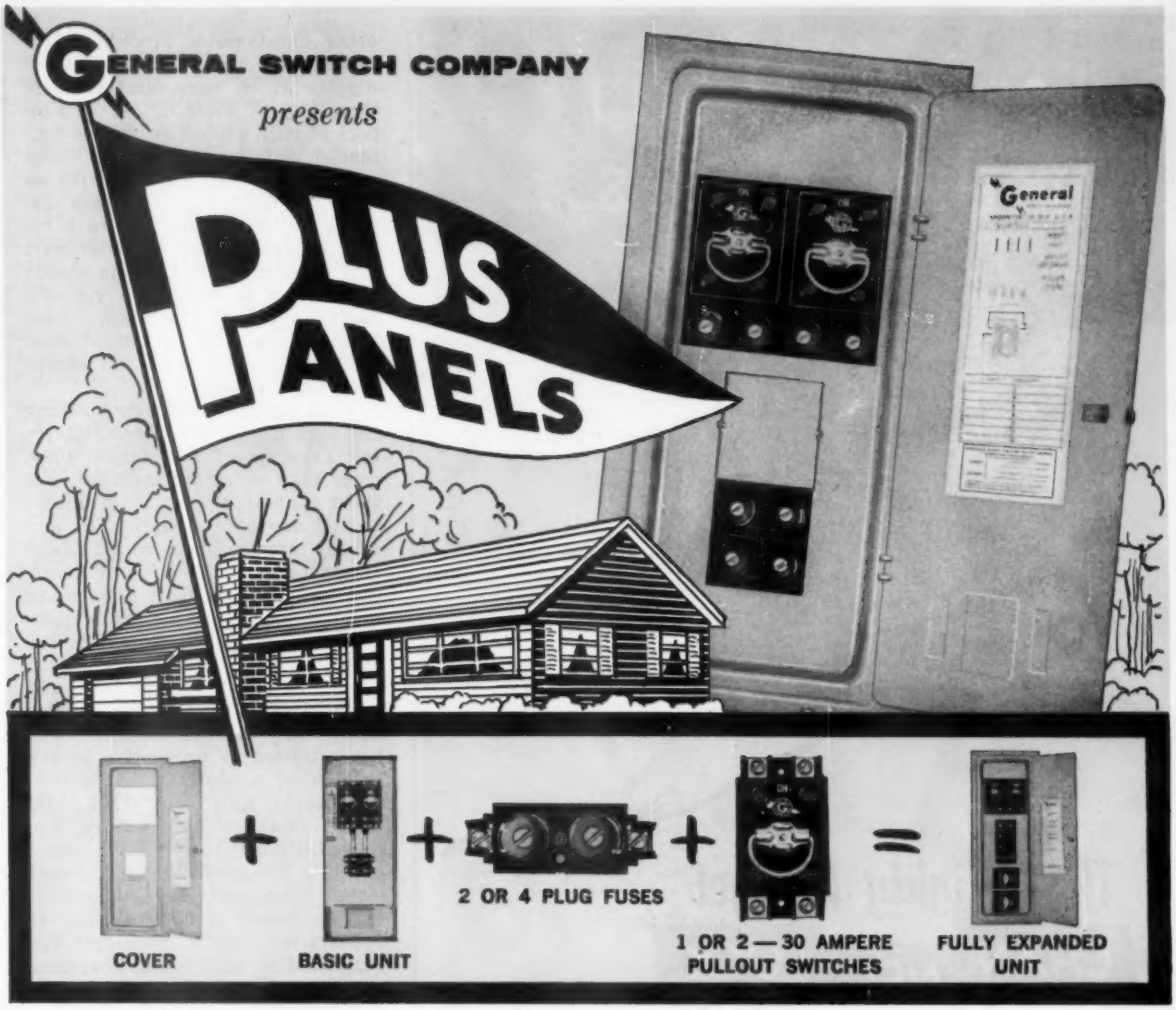

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other questionable procedure concerned the use of short conduit nipples which were filled to more than 40% of their C.S.A. In support of such procedure, it was contended that the 40% fill was based on long runs of conduit with as many as four quarter bends between outlet and outlet. As a result, it was difficult to understand why a short conduit nipple should be subject to the same requirements, and some inspectors were tolerant on this question even though the code made no exceptions in this respect.

Your question primarily concerns the derating of the current-carrying capacity of conductors when more than three are installed in a short conduit nipple. I am unable to find any code exception, or any official interpretation which would eliminate the application of derating factors when short nipples are involved as described in your question. I do believe however, in the case shown by the illustration, that the heat generated in the panel will accumulate at the top of the panel and its flow through the nipple will be restricted in proportion to the number of conductors in the conduit nipple. As a result there could be an excessive temperature, due to panelboard heat, which, when added to the conductor heat, would expose the conductors to a temperature in excess of their rating. It appears however, if the nipple was restricted to a 20% fill, the same as the gutter, that some recognition might be given to the installation of as many as 30 conductors with no derating factors. Such procedure however is not recognized by the code.

A summary of the foregoing indicates that the code does not recognize the installation of more than nine conductors in a conduit for the application shown, and when more than three conductors are installed in the conduit the derating factors must be applied. In order to fully satisfy code requirements, I would suggest the elimination of the conduit nipple, and bring the gutter direct to the panelboard.—B.A.McD.—2/59/10

Service Disconnecting Means

Q. *I am writing to you for a clarification of an argument on Section 2351-A of the National Electrical Code. Our city manager says we are to follow the NEC in*

our wiring methods. We have a discussion going on at the present time and your answer would straighten us out. In the new houses I have been installing QO12 circuit boxes in smaller houses and QO20M circuit boxes in the larger houses. The QO20M has a 100-amp built-in main disconnect. The problem comes in installing the QO12 without a disconnect. One of the meter men say I am violating the code by installing a 12-circuit box without a main disconnect switch, if I only put three or four single pole 115-volt circuits in it, and leave the rest of the box for future use.

As I interpret the code I do not have to install a disconnect ahead of the single pole circuits until I have added the seventh circuit. Am I right or wrong? When the seventh circuit is added it will be a violation, if a disconnect is not installed.

He also contends that a 50-amp double-pole block serving an electric range is two circuits. I say No, only one circuit. As I understand the NEC I could install one 220 dp circuit for an electric stove or one 220 dp circuit for an electric dryer or one 220 dp circuit for a room air conditioner and three single pole 115-volt circuits for the lighting and receptacles and still not violate the code concerning a disconnect means. The service here is 115/230-volt, 3-wire, the 220-volt dp circuits have the handle ties.—K.K.

A. It is difficult for me to understand the logic which prompts a contractor or builder to install service equipment that is designed to handle future loads, and not at the same time fully satisfy all service code provisions which are involved when such future loads are installed. I know from past field experience the adverse public relations which occur when a property owner finds, after a year or two occupancy in a new home, that he must renovate his service equipment, at a considerable expense, so that he may install some new appliance, or a few more branch circuits. Such adverse reaction has been a reflection on our wiring industry, even though we may not be fully at fault.

According to the provisions of Section 2351-a, the service disconnecting means shall be of a type approved for service equipment and for prevailing conditions. In order to satisfy Underwriters' Laboratories in this respect, the service equipment in question is required to have a UL label which indicates suitability of use as service equip-

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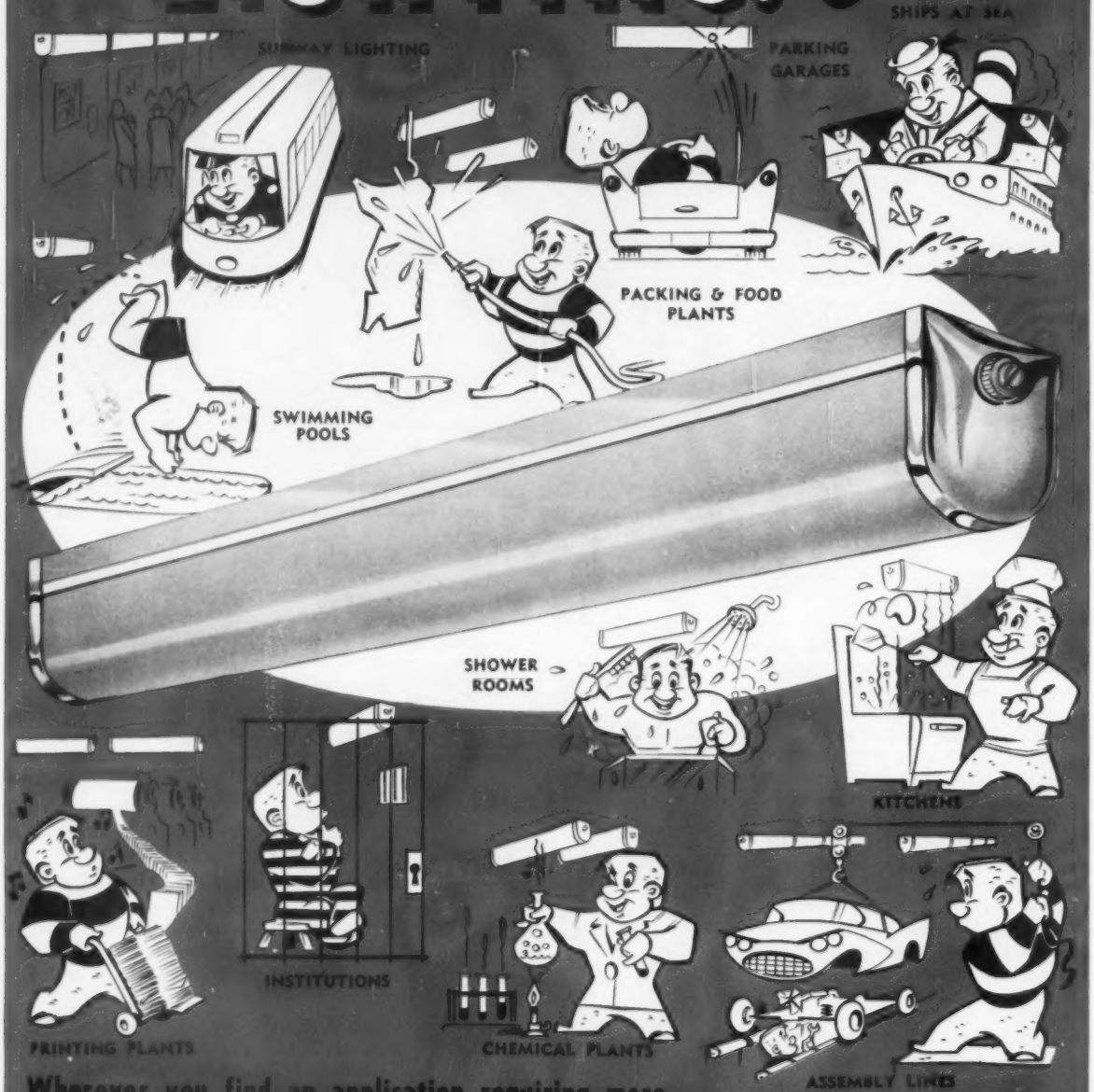

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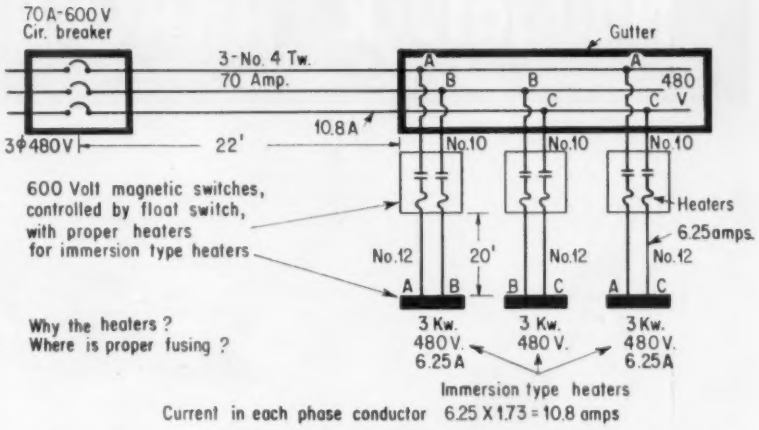
ment. I am inclined to believe that the QO-12 circuit breaker panelboard, which contains 12 single pole circuit breakers, would not be labeled. I realize however that when each set of two breakers are equipped with "handle ties" we would have six sets of disconnects which would satisfy the code, and possibly UL. I assume that this is not so in the case in question. If the panelboard in question carries the UL label, and "handle ties" are to be used, as above covered, there appears to be no code violation. If the panelboard is not labeled, it then becomes the responsibility of the local inspector to decide the suitability of use as service equipment.

Insofar as a literal reading of Section 2351-a is concerned, I do not believe there is any code violation when six single-pole breakers are installed, even though provisions are made for future circuits. The situation is similar to that which prevails when a 400-amp service switch is served with 200-amp conductors. You cannot criticize an installation on the basis of what may occur in the future. Such procedure, for the reasons previously outlined, is highly undesirable in my opinion. Another factor to be considered concerns the fact that breakers larger than the ones originally installed may be readily substituted. Under such conditions a serious hazard could result when no main disconnect is installed.

Insofar as the 50-amp double-pole block serving a 115-230-volt range is concerned, we have a 2-pole combination switch and fuse which, according to the third sentence of Section 2351-a, is recognized as a single disconnect. According to the fine print note following Section 2371, "A set of fuses is all the fuses required to protect all of the ungrounded conductors of a circuit." As a result, such a combination device is considered to be one disconnect and one set of fuses. I fully agree with your concept of these code rules.—B.A.McD.—2/59/11

Overcurrent Protection —Conductors and Appliances

Q. *Will you please refer to specific sections in the Code that pertain to the illustration shown here? The magnet switches contain heaters of a size that would normally be determined if the loads were motors. I personally fail to see proper protection on the taps.—R.C.M.*



A. The first thing that appears peculiar about the wiring diagram submitted is the fact that the total load served consists of three single-phase 3-kw, 480-volt heaters, connected over the 3-phase conductors. Such a load only draws 10.8 amps over each phase conductor. Your diagram specifies a 70-amp breaker and No. 4 conductors, hence it appears that loads in addition to the immersion heaters are connected to the same circuit. Since other factors may be involved, I hesitate to offer any further comment on this point.

It appears to me that the immersion heaters come within the scope of the definition of an appliance. As a result, they are subject to the code provisions of Article 422. Reference to Section 4243 shows that the heaters are required to have overcurrent protection as specified for the various types of branch circuits covered by Article 210. Reference to Section 2126 indicates that an appliance of the type shown cannot be served by a branch circuit rated at more than 30 amps. It therefore appears that this rule is violated.

According to the provisions of Section 2404 "Thermal cutouts, thermal relays and other devices not designed to open short-circuits, shall not be used for protection of conductors against overcurrent due to short-circuits or grounds but may be used to protect motor branch circuit conductors from overload if protected in accordance with Section 4330." Since the heaters involved with magnetic switches usually are not designed to protect conductors from short-circuits or grounds, this section of the code is violated.

According to the provisions of Section 2403, conductors shall be protected in accordance with their current-carrying capacities, as given in Table 1, 1A, 2 and 2A of Chapter 10. There are several exceptions to this fundamental rule, none of which appear to be concerned with the application in question.

A summary of the foregoing indicates to me that the heaters shown should be served by a branch circuit rated not greater than 30 amps, or overcurrent devices should be installed where the No. 10 taps are connected to the 70-amp feeder. —B.A.McD.—2/59/12

NEW FEATURES of office business machine, developed to help electrical contractors reduce record keeping costs, are pointed out to Vincent Burkhardt (seated), Burkhardt Electric Co., West Palm Beach, by Ribert Sjostrom, area manager for National Cash Register Co., during Electrical Trade Show and annual convention of Florida Assn. of Electrical Contractors, held recently in West Palm Beach.

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Los Angeles Conference Discusses Glare Losses

In spite of constant advances in the technology of applied illumination and in the design of lighting equipment, the maximum possible effectiveness of school and office lighting is being curtailed by 50% or more as a result of unscientific placement of fixtures and the resultant creation of reflected glare on working and reading surfaces.

This pronouncement, based upon five years of extensive study by Dan M. Finch, professor and research engineer in the University of California's Department of Engineering at Berkeley, was emphasized when a group of educators from the States and Canada, utility lighting consultants and members of the trade press convened in Los Angeles early last month.

Professor Finch's report was based upon laboratory research sponsored by the Illuminating Engineering Research Institute, while practical analysis of his theoretical findings were suggested by Charles Gibson, Chief of the Bureau of School Planning for California, and by C. L. Crouch, IERI Secretary and Technical Director of the IES. Additional interpretations and clarifications were also submitted at the conference by Professor Everett M. Strong from Cornell University, Ithaca, N. Y., and by John M. Chorlton, Chairman of the Board of Education, Toronto, Canada. The presentation of substantiating data was effectively accomplished through the use of slides, film clips, charts, blackboard sketches, mock-ups of typical lighting installations and demonstrations of various fixture arrangements.

In defining the scope of his work, Professor Finch explained that his assignment was to review changes in visibility occurring when typical schoolroom tasks are viewed under various lighting conditions that include specular reflection components. Typical classroom seeing tasks which were considered in this analysis included samples of printed material on matte paper and on coated book stock as well as handwriting in both ink and pencil on various types of paper.

In these tests (of which several thousands were conducted, evaluated and plotted on a series of graphs) visibility evaluations were limited to viewing angles which were 25 degrees to the normal. The tests proved that maximum glare with corresponding reductions in contrast and visibility occurred when the center of the specular light source was directly in front of the viewer and located so that the angle of reflection from the task area exactly equalled and opposed the viewing angle. Deleterious conditions progressively lessened as azimuths and inclinations of light rays deviated from these fixed positions.

While this phenomena has been previously recognized, it has never before been evaluated. Now, however, by using two different types of microphotometers to obtain brightness factors for minute areas of a task area, Professor Finch was able to subjectively equate contrasts and resultant visibility values under various lighting conditions.

To obtain these data, typical schoolroom lighting conditions were created at the U. of C. engineering field station at Richmond, Calif., with various combinations of fluorescent and incandescent fixtures mounted at various angles to the normal reading position and separately controlled so that the brightness of each lamp could be separately increased or diminished, and each fixture could be masked to govern the direction of its rays. Circuiting was arranged so that light on the test area could be varied from 15 to 130 footcandles. Luminaires were also arranged so that top reflecting plates could vary light patterns from totally direct to generally diffuse.

RESIDENTIAL LIGHTING market in Florida only is a $10 million annual market, based on sale of $100 worth of fixtures per home, James R. Ward (standing), president of Ward Electric, Inc., Bradenton, Fla., told members of the Florida Association of Electrical Contractors at their annual meeting in West Palm Beach recently. Seated is R. H. "Dick" Palmer, FAEC President during 1958.

In discussing brightness concepts, Professor Finch explained that every surface will have an individual pattern of brightness factors depending upon the material, texture, special absorptance and reflectance, also upon intangibles related to gloss and sheen. In such patterns, brightness factors for specific sets of conditions are obtained by relating brightness of an area (measured in footlamberts) to general illumination (measured in fc). That is, the brightness factor is a value by which illumination normal to a surface is multiplied in order to obtain brightness in a particular direction.

Demonstrations performed at the Los Angeles conference showed how brightnesses of backgrounds and objects superimposed on those backgrounds may change excessively as the angle of light incidence changes in relation to a given viewing direction. These changes were so marked that in some instances contrasts changed from positive to negative values due to specularly reflected light.

In summarizing his remarks, Finch stated that a lighting system that develops a given contrast in a particular task will have a measureable visibility associated with that contrast and that, if the lighting system is changed so that the contrast is reduced, the visibility will also be reduced. It was further pointed out that the higher the illumination due to well distributed general lighting, the less will be the percentage contribution of the specular components to the total illumination.

This implied that if a general lighting system is installed to give a high value of illumination by using many individual sources or large area sources, the importance of a specularly reflected component becomes less and less.

It was therefore concluded that at least 30 fc of minimum general

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illumination from well distributed sources was essential to overcome the deleterious effects of specular components from individual light sources located in the specular region of a reading-type visual task. And these deleterious effects of specularly reflected components may disappear almost completely when general illumination levels are raised to 50 fc or more, provided care is exercised to prevent the corresponding increase in the specular components.

In other words, a small high-brightness source at the angle of specular reflection can be tolerated so long as it produces only a small amount of illumination at the task. Or, stated conversely, the effect of the brightness of a fixed specular component increases as the total illumination on the work is reduced to lower levels.

In commenting upon Professor Finch's work, Mr. Gibson stated that such research was immeasurably valuable, although designers of school and office lighting systems had to consider general areas, general tasks and general viewing conditions rather than enjoy laboratory conditions wherein a single person could maintain carefully positioned viewing angles and lighting placement. He also pointed out that conditions which are ideal for one student might create considerable discomfort or visibility hardships for students at desks somewhat removed from the ideal location. Moreover, he continued, school boards are generally faced with budgets that do not permit specifying what is admittedly best; therefore compromises are necessary to obtain reasonable results from reasonable investments.

This thesis, he concluded, pointed to two general rules of application. First, by adopting luminous ceilings or semi-indirect lighting systems, lighting components that produce glare would be lessened in proportion to the overall illumination in the room. And, second, conditions of a seeing task could be improved by using low-gloss papers and writing instruments other than hard-carbon pencils.

These general conclusions were likewise endorsed by C. L. Crouch, who stated that as much as 65% of the effectiveness of most school lighting installations is being lost because fixtures have been positioned unscientifically, and that conditions could be improved materially by avoiding bare lamps, placing diffusing shields beneath them to obtain better distribution

TRIO OF SPEAKERS, opening the fall meeting schedule of the two-chapter, 650-member Electrical Maintenance Engineers Division of the Electric Association of Chicago, comprised: (L to R) George Albiez, president, Englewood Electric Supply Co.; Leo Witz, president, Continental Electrical Construction Co.; and C. B. Thorsen, president, Electric Association and district manager, Day-Brite Lighting, Inc. Subject: Services available to industry from electrical distributors, electrical contractors, and the Electric Association.

of light, promoting general rather than direct reflection conditions, and raising overall footcandle levels (in accordance with new IES recommendations based on the Blackwell report) so that individual sources of reflected glare are minimized in their overall relation to the whole.

This conference emphasized the importance of research work being made possible through grants from the non-profit independent Illuminating Engineering Research Institute, the same organization that sponsored the widely publicized 8-year study of Dr. H. R. Blackwell at the University of Michigan.

Other research projects now in progress under the same sponsorship include studies at Cornell University, Ithaca, N. Y., being made by Robert C. Bradley to determine the effects of glare from luminous ceilings, illuminated walls and large windows; studies at the University of Texas at Austin being conducted by Dr. Harry Helson to compare color changes in daylight and under various artificial types of illumination; and studies at Pennsylvania State University at University Park, where Charles March is finding that visibility through fog can be improved by 100% or more by providing highway and vehicle lighting as perpendicular to the driver's line of sight as possible.

This broad program of research is also considering such future projects as the determination of lighting requirements by subnormal eyes; a study of color re-

quirements for moving tasks; the determination of limits of brightness differences for the moving eye in rooms; the development of design data for improved visibility through fog; the measurement of additional school and office tasks to influence recommended practices; plus many additional equally important studies.

Leasure Is NECA V.P. for Dist. 4

Elmer E. Leasure, Jr., president, Monroe Electric Company, Chicago, has been elected a vice president of the National Electrical Contractors Association. He heads the Association's District 4 embracing the four-state area of Illinois, Indiana, Michigan and Wisconsin.

Mr. Leasure, widely recognized as an expert in labor relations, is completing ten consecutive years as president of the Electrical Contractors Association of City of Chicago—the local NECA Chapter. He has also served on various committees of other well known industry organizations.

Ferrari Heads Chicago EMSA Group

Bernard Ferrari, Jr., Excel Electric Service, Chicago, is the new president of the Electric Motor and Service Association (Central District Chapter, NISA). Other officers elected to guide the association activities for the next year are: vice president—Sigmund Pluskota, Pluskota Electric Co.; secretary—W. J. Billings, Ebling

NEW electrical construction products and their use in the expanding Florida building program were discussed by (l to r) Donald H. Nicol, Square D Co., Tampa, Max Booker, Booker Elec. Co., Lakeland, and W. T. Sarns, Southern Electric Co., Jacksonville. Occasion was the Electrical Trade Show and annual convention of the Florida Assn. of Electrical Contractors, held recently in West Palm Beach.

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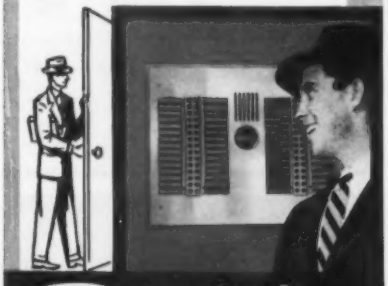

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JOB PROGRESS is one responsibility of M. L. "Bud" Hayes, project electrical superintendent for The Keating Company of Des Moines, Iowa. Bud's latest project is Maytag's new multi-million dollar office building in Newton, Iowa, in which the electrical system was specifically designed for modular office flexibility.

Electric Company. H. W. Reeve, Inland Industrial Electric Service, was re-elected treasurer for another term.

Members serving as association directors are: Clarence Sievert, Sievert Electric Co.; W. L. Kaska, Chicago Electric Co.; A. J. Lewus, Lewus Electric Co.; Walter Lucke, Condo Electric Co.; Jay Almerico, Avena Motors; Elmer Jandt, C & H Electric Co.; Thomas Callaghan, Bowers & Clark; and Abe Marcus, Ther Electric & Machine Works.

Engineers Urge Fee Formula for Public Construction

A resolution passed at the 34th annual meeting of the New York Association of Consulting Engineers urged the city to adopt the same fee formula for its construction as prevails in regular engineering practice. A fees committee of the association reported that "progress has been slow and in large part disappointing" in its efforts "to improve engineering fees for projects of the City of New York, in particular public schools".

The resolution stated, "An adequate fee for engineering services should be based on an amount equal to two and one-half times the net time card costs of the design staff engaged on the work. This formula is a well established one, is widely used in our private practice and has found a fairly general acceptance all over the country."

In arriving at the recommendation, the committee said they "had obtained actual data from members as to drafting costs on both structural and mechanical projects for all types of public buildings". The data showed actual fees received and compared them with an adequate fee, based on 2½ times drafting costs.

"Results for schools showed a rather remarkable uniformity. The figures for public works jobs presented no particular pattern, but proved quite clearly that public works fees are hopelessly inadequate."

The committee also reported they had conferred with the national associations of architects, civil engineers and others, and found that the fee schedules of those groups ranged from a multiplier of two and two-tenths for very large jobs to three for smaller jobs.

The NYACE includes the leading electrical engineers in New York City. Its members are largely responsible for the engineering design that goes into the major building construction in the city.

IES Chapters Now Number 84

The Illuminating Engineering Society christened another baby last December when Arrowhead Chapter, San Bernardino, Calif., received its official charter from regional vice president Jim Barnes and thereby became the 84th member of the IES family.

Presentation of a gavel to Gordon Burgess, the incoming chapter's first chairman, likewise was a highlight of the occasion, for the presentation was made by Irwin McMath who, as chairman of the September-chartered Yosemite Chapter, Fresno, represented another "infant" in the Society's clan. Completing the business of launching the new group, new officers were formally installed. In addition to chairman Burgess, officers included Jack Adams, vice-president; William F. Ritter, Jr., secretary-treasurer; C. G. Dahlgren, Dr. John Gorham, Ken Matsuoka and Clyde Soden, managers.

Following the business portion of the meeting, J. S. Hamel, consulting engineer and member of the Board of Managers of the Southern California Section, presented an illustrated talk on "Illumination Highlights at the Brussels World Fair" which he personally inspected last August.

National Lighting Show To Be Held

The Second National Lighting Exposition will be held at New York's Coliseum March 1-4, and all signs point to a record attendance of more than 20,000 from the lighting industry and its related fields. This Exposition, a privately sponsored affair, will feature a two-part program again this year similar to that used at the first Exposition held a year ago.

One attraction will be a four-day trade show, in which over 200 lighting equipment manufacturers, representing a complete cross-section of the lighting industry, will display their new and modern products and designs, including many new products not previously announced or shown. This part of the program opens on Sunday, March 1, at 12:30 PM when, George J. Taylor, president of the Illuminating Engineering Society, opens the Exposition with a keynote address.

Of equal interest will be the second part of the program, which consists of twelve scheduled panel discussions centered around the show's theme, "New Dimensions for the Footcandle". Taking part in these symposiums will be forty nationally known authorities representing all facets of the lighting industry. Symposiums begin at 10:00 AM daily, and run to 3:00 PM, on March 2nd, 3rd and 4th. Exhibits will be open from 12:30 PM to 8:00 PM on Sunday, March 1, and from 3:00 PM to 10:30 PM on the following days.

Title for the opening Symposium will be "Where Are We Going In

NEW OFFICERS of Central Chapter, Electrical Maintenance Engineers of Chicago are: (L to R) vice chairman E. T. Rudman (Revere Copper & Brass, Inc.); and chairman H. D. Manship of Central Soya Co., Inc., Chicago.

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FINE QUALITY and SKILLFUL WORKMANSHIP are the distinguishing features of Arro Toggle Bolts.

This well made toggle bolt makes fastening to tile, plaster, wall board, or any type of hollow construction, quick and sure. Its lively spring, when released, spreads the steel wings into open position —tightening develops maximum holding power.

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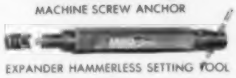
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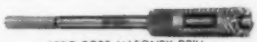
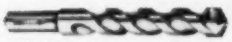
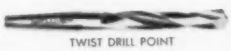

ARRO-CORE MASONRY DRILL

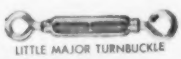

ARROFLUTE CARBIDE MASONRY DRILL

FOUR-FLUTE HAND STAR DRILL

FOUR-FLUTE DRILL POINT


TWIST DRILL POINT

RUBBERGRIP DRILL POINT HOLDER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Lighting". Moderator for this panel will be C. M. Cutler, Lamp Department, General Electric Co., and panelists will be Abe H. Feder, lighting consultant, Dr. Samuel G. Hibben, past-president of IES, and J. Gordon Carr, architect. Other Symposium subjects will include: Office Lighting; Street and Highway Lighting; Light and Architecture; Institutional Lighting; Lighting for Selling and Color; Polarization—Its Relation to Lighting; New Ideas and New Techniques in Residential Lighting; Industrial Plant Lighting; Outdoor and Recreational Lighting; and Theatre and Television Lighting.

NISA News

New national headquarters were opened in February by NISA at 7730 Carondelet Avenue, St. Louis 5, Mo. "Additional space for our various departments as well as a more convenient location will enable the national staff to serve the electric motor, generator and transformer industry more efficiently," executive vice-president Joseph M. Harrington said.

• • • •

NISA's Mid-South Chapter will hold its spring meeting in Mobile, Ala., at Holiday Inn Motel on Dauphin Island March 13-14. Tom Russell, of Russell Electric Co., Mobile, is in charge of arrangements. The spring meeting is for foremen and supervisory personnel.

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Mrs. Carl I. Schaeffer, wife of the owner of the C. I. Schaeffer Electric Co., St. Louis, was named a Woman of Achievement for 1958 by the St. Louis *Globe-Democrat*. Mrs. Schaffer and her husband have 16 children, including a son, Gerry, who is president of the Greater St. Louis Chapter of NISA.

• • • •

Gertrude Kiemle, sister of the founder of The Fred W. Kiemle Co., of Toledo, Ohio, retired recently after serving as secretary to the general manager of the company for 20 years. She was honored during the firm's Christmas party and given a diamond wrist watch to commemorate the occasion.

• • • •

S. J. Stewart, of S. J. Stewart (Electric), New Orleans, and Charles W. Hiers, of New Orleans Armature Works, were honored recently by their city's chamber of commerce for their efforts in behalf of the 1958 NISA Jubilee Celebration last May.

• • • •

The first annual New Year's Party was held on January 17 by Western Michigan Chapter, in Grand Rapids, Mich.

EME CERTIFICATE is presented by Charles Truckenbrodt of G.M.'s Electromotive Division to Clarence Frederickson (left) of Corn Products Refining Co., Chicago, in recognition of his term as chairman of the Central Chapter, Electrical Maintenance Engineers of Chicago.

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Puget Sound Chapter met on January 6 at Benjamin Franklin Hotel, Seattle, Wash., for a round-table discussion on "relations with the buying public."

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Albert S. Barnes of the Bell Telephone Co. of Pennsylvania was guest speaker at the January 14 meeting of Quaker City Chapter, speaking on the topic, "The Mighty Midget," the transistor.

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A tour of Canada Wire and Cable Co.'s Simcoe, Ont., plant highlighted the November meeting of Ontario Chapter.

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Robert Starkle of General Electric Co., Fort Wayne, Ind., discussed future production of fractional horsepower motors at the Birmingham, Ala., meeting of Mid-South Chapter.

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Metropolitan Miami members of NISA convened December 17 at Clifford's Restaurant to hear J. Arthur Turner Jr., of Tampa (Florida) Armature Works, national secretary of NISA.

• • • •

George K. McKeowan of MQN Electric Service, Mentor, Ohio was elected president of Greater Cleveland Chapter at a meeting November 17 at Cleveland Engineering Society. E. D. Jolley Jr., Electrical & Mechanical Service Co., Elyria, Ohio was chosen vice-president; Don Fowler, Reserve Electric Co.,

Cleveland, was elected secretary; and Lee Ruppersberg, also of the Reserve company, treasurer.

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NISA's new exhibit was unveiled at the Plant Maintenance & Engineering Show in Cleveland January 26-29 at Public Auditorium. The new portable booth features large cutouts of a transformer and stator plus eight black and white and twelve color photographs of actual shop scenes. A map with a flashing background indicates the approximate areas served by the 1600 NISA members, located in all 49 states, Canada and Mexico.

• • • •

Bernard Ferrari of Excel Electric Service was elected president of Chicago Chapter at a meeting January 9. Other officers are: vice-president, Sigmund Pluskota, Pluskota Electric Co.; secretary, W. J. Billings, Ebling Electric Co.; treasurer, H. W. Reeve. Directors include Clarence Sievert, Sievert Electric Co., W. L. Kaska, Chicago Electric Co.; A. J. Lewus, Lewus Electric Co.; Walter Lucke, Condo Electric; Jay Almerico, Avena Motors; Elmer Jandt, C&H Electric; Thomas Callaghan, Bowers & Clark; and Abe Marcus, Ther Electric & Machine Works.

• • • •

Yankee Silversmith Restaurant was the site of the November 6 meeting of Connecticut Chapter, convening in Hartford. The group held its annual Christmas party December 6 at Colonial House.

• • • •

Great Lakes Chapter's Christmas

KEY MAN in the large motor and equipment repair department of Electrical Engineering & Equipment Co., Des Moines, Iowa, is shop superintendent James Bailey. With an eye to better customer service, he's constantly searching for more efficient shop techniques and encourages his mechanics to think along those lines.

COUNT ON SHURE-SET

here's fastening versatility you have never experienced before

Time- and money conscious electrical contractors everywhere are using Shure-Set on countless light-fastening jobs. Requiring no cartridge, this unique tool makes every hammer stroke more effective . . . permanently sets "job-fitted" threaded studs, drive pins or wire loops into concrete, light steel or masonry faster and easier. A wide variety of fasteners makes the toughest fastening job easy with Shure-Set.

Forget drilling, filling, plugging, expansion bolts, concrete nails—Shure-Set eliminates them and gives a better fastening, too! Find Shure-Set under "Tools" in the Yellow Pages—call and find out how Shure-Set will fit into your operation.

In addition to hammer-in Shure-Set, the versatile Ramset Fastening System includes Ramset powder-actuated tools for heavy-duty fastening, and Ringblaster heavy-duty kiln gun.

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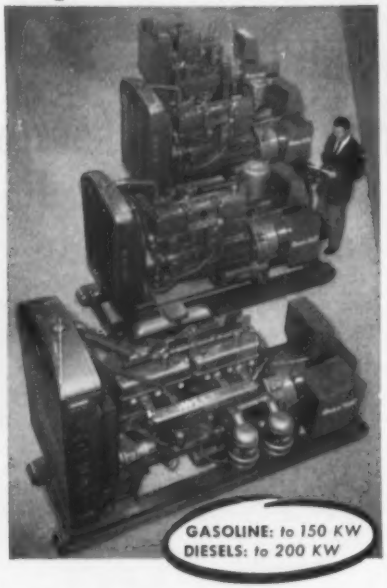
Now...Onan Electric Plants up to 200KW!



Equipped with new Magneciter Generator*

Now you can have Onan engineering and Onan dependability in high-capacity plants, too! In gasoline-powered models, 100, 125, and 150KW sizes have been added. New diesel models start with 10KW and include 15, 25, 35, 50, 60, 75, 100, 125, 150, 175 and 200KW capacities. All standard voltages are available.

All models are powered by heavy-duty industrial engines matched to the power requirements of the generator. Custom modifications to meet particular needs add to the versatility of the new Onan line. Automatic controls for standby installations are available for each model. Magneciter generator is standard equipment on units of 100KW and larger.

Magneciter gives these advantages

- **Simplicity** — Eliminates hundreds of connections, the commutator and brush rig.
- **Constant voltage**—Voltage dip is less than 20% with motor starting load. Two-second recovery.
- **Lighter weight, more compact**—Plants are shorter by a foot or more, lighter in weight.
- **Less maintenance, easier servicing** — Static exciter and regulator are externally mounted, easily accessible.

**Onan alternator with static excitation and static voltage regulation.*

Write for specification kit!

Onan builds electric plants from 500 watts to 150KW, gasoline-powered; 3,000 watts to 200KW, diesel-powered.

Onan
ELECTRIC PLANTS

D.W.ONAN & SONS, INC.
2695 University Ave. S.E., Minneapolis 14, Minn.

Party was held December 11 at Hawthorne Country Club near Detroit.

• • • •

Another Christmas party that attracted a big throng was the one held by Los Angeles Chapter on December 9 at Michael's Restaurant.

• • • •

Al Ekdall of Insulation & Wires Inc. was guest speaker at the Northern California meeting in Sacramento on October 17. He discussed magnet wire and improvements in insulation.

• • • •

A meeting of Ontario Chapter was held on January 22 in Toronto at Lord Simcoe Hotel.

• • • •

The annual spring technical meeting of Southeastern Chapter will be April 10-11 at Robert Myers Hotel, Jacksonville, Fla.

• • • •

A meeting of the International Convention Committee of NISA was held last month in Montreal, P. Q., site of the event May 17-20. General chairman D. D. Bishop, Montreal Armature Works; national vice-president H. C. Blenkhorn, of Blenkhorn & Sawle Ltd., St. Catharines, Ontario; exhibits chairman Paul Barbeau of Montreal Armature Works; entertainment chairman, Jean Clermont, of Leduc Electric Co., Montreal; program chairman C. J. Ainsworth, of Ainsworth Electric Co., Toronto, Ontario; NISA executive vice-president Joseph M. Harrington; and *NISA News* editor Horace B. Barks attended.

H. E. Bayley Re-elected President Puget Sound Chapter

Howard E. Bayley, Industrial Electric Co., has been re-elected to his second term as president of the Puget Sound chapter, NECA, for 1959. Before becoming president last year, he had served as governor in 1957.

The new vice president of the chapter is Kernan Dennis, president of the Northwest Electric Co. Oscar Olson of Salmon Bay Electric is serving his second year of a three-year term as chapter governor.

Donald W. Close, Irving Chapman, Lloyd Larsen, Frank Holert, Charles Meagher and Ken Hills were elected to the board of directors.

NEW OFFICERS of Florida Association of Electrical Contractors for 1959 were elected and installed at the October FAEC annual convention in West Palm Beach. They are (l to r) Wallace Ornberg, Curry Electric Co., Orlando—Secretary-Treasurer; C. Wesley Olson, Jr., (with gavel), Olson Electric Co., Daytona Beach—President; R. H. (Dick) Palmer, Jr., Palmer Electric Co., Lake Worth—Past (1958) President; James R. Ward, Ward Electric Co., Bradenton—1st Vice President; and (not in picture) John E. Gabrio, St. Petersburg—2nd Vice President. King size gavel was presented to President Olson by retiring President Dick Palmer during installation of new officers.

Commercial Wiring Promotion Available

The National Wiring Bureau, as part of its commercial wiring program, has prepared a booklet covering all of the many ways electricity can help merchants and owners of commercial enterprises to increase sales and profits. Titled "The Big Difference Is PLANNED PROFIT POWER," this promotion piece should have a place in the sales program of every utility, distributor and contractor interested in cultivating this market.

The booklet uses illustrations, testimonials, and before-and-after case histories from many different types of business to prove that electrical modernization pays. It introduces wiring as the key element in any modernization. It concludes with specific applications of wiring materials and a self-analysis check list.

"The Big Difference . . ." will help power salesmen to illustrate how improved electrical facilities will attract more customers and serve them better, quicker and at lower cost. It will help contractors and distributor salesmen visualize, for their customers, the possibilities of similar improvements in their own businesses.

It can be used as a "show-piece" —or reference item in personal calls. It can be used as a hand-out

piece at meetings, trade shows, displays, or over-the-counter.

Offered in advertising, "The Big Difference . . ." can be a source of prospect leads, as well as pre-selling the recipient. The National Wiring Bureau plans to use it in just this way, throughout 1959, in national advertising—forwarding the leads to you for follow-up. NWB suggests that you supplement this advertising with similar insertions in local trade journals.

Quantities of "The Big Difference . . ." can be ordered from the National Wiring Bureau, 155 East 44th St., New York 17, N. Y. Ask for Catalog No. CB-100. Prices: 22 cents each for the first 100, 20 cents each for additional copies, forwarding charges extra.

Mats of the initial national ad introducing the booklet, coarse-screened for newsprint, are available at 50 cents apiece; electrotypes for magazine insertions are available at $10.00. Reproducibles of the ad, for offset printing, are free on request.

The National Wiring Bureau also has folders which can be used with "The Big Difference . . ." to build direct mail campaigns for many different businesses.

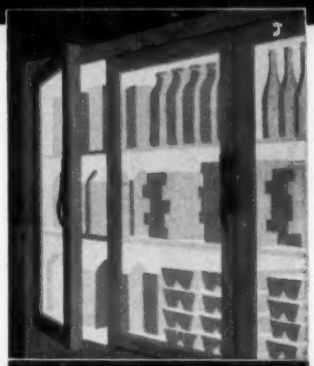
J. C. Boydston Named President

John C. Boydston has been named president of the Central New Mexico chapter, NECA, at Albuquerque. Other new officers are J. H. Boone, vice president; James J. Watson, treasurer, and John N. Yearout, member of the board of governors.

ENTERPRISING motor shop operator G. L. Wagner, Wagner Electric Co., Ft. Wayne, Ind., with adapter bracket and ring he developed and marketed to permit use of standard NEMA motors on a specific type of hot air furnace circulating fan and well pump equipped with special mounting features.

BRONCO Certified 66

electrical cord flexed 300,000 times without failure!



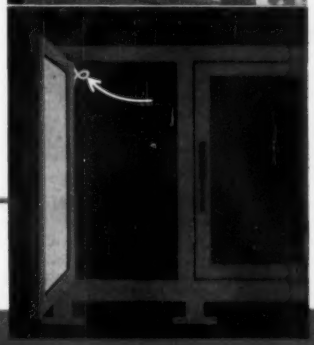
WEBER SHOWCASE AND FIXTURE CO., INC., largest manufacturer of refrigerated display cases and market equipment in the west, required an extremely flexible electrical cord for a new reach-in refrigerated dairy and beverage case.

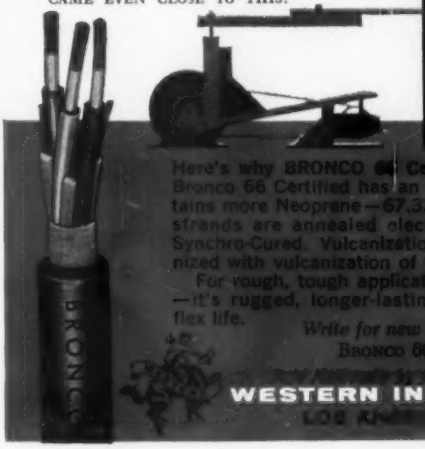
The cord is twisted and flexed through a 100° angle each time the door is opened. Again, each time it is closed.

Specifications called for a piece of #18, 3 conductor, type SJO cord that would withstand 50,000 cycles.

A piece of BRONCO 66 Certified Type SJO, procured from stock, was placed in the electrically driven test mechanism.

The BRONCO 66 Certified cord was *flexed through 150,000 cycles!* — 300,000 bends and twists! — three times more than the specifications called for! The test was discontinued. No failure, no apparent damage to conductors or jacket; the wire still operated perfectly. NO OTHER CORD TESTED CAME EVEN CLOSE TO THIS!





Here's why BRONCO 66 Certified won the Weber flex test: Bronco 66 Certified has an outer protecting jacket that contains more Neoprene—67.32% of Dupont Neoprene. Copper strands are annealed electrically. Bronco 66 Certified is Synchro-Cured. Vulcanization of the insulation is synchronized with vulcanization of the jacket.

For rough, tough applications specify Bronco 66 Certified —it's rugged, longer-lasting, more flexible, with greatest flex life.

Write for new quick reference catalog of BRONCO 66 Certified Big Cables

WESTERN INSULATED WIRE CO.

LOS ANGELES 58, CALIFORNIA

lighting design by mcPhilben

Cast Aluminum Quality

mcPhilben's 32-88 square ceiling unit is UL-approved for two 100 watt lamps. Its clean, modern lines, combined with maintenance-free operation, make it the ideal choice for institutions and industry: corridors, lobbies and lavatories.

The 32-88's face plate is of solid cast aluminum with a gleaming satin finish. Corrosion resisting construction features a reinforced and insulated back plate of zinc-clad bonderized steel. The cast carrara glass bowl swings to one side for easy cleaning. Available with mcPhilben's exclusive one-piece cast aluminum hinged guard. Also in vaportight 43-88 series.

Ask your nearby mcPhilben representative for full details. See our insert in Sweet's file 32a/mc or write for data sheet.

mc Philben
LIGHTING COMPANY
1339 Willoughby Avenue
Brooklyn 37, New York

TRIO of Ombergs at recent annual convention of Florida Assn. of Electrical Contractors in West Palm Beach are (l to r) Gust, Axel and Wallace—father, son and grandson. Axel and Wallace own and operate Curry Electric Co., Orlando, Fla.

REA Interest Rates Under Scrutiny

One of the Eisenhower Administration's economy proposals, included in its $77 billion balanced budget for fiscal 1960, includes a plan to raise the interest rate charged on loans made by the Rural Electrification Administration to its 986 rural electric co-operatives. The current interest rate is 2%, which was fixed by law in 1944, whereas the U. S. Treasury Department has recently had to pay 4% and more in its borrowings of long-term money. Also, the Administration wants to require REA co-ops to borrow at least part of their expanding money needs from sources outside the Government.

Currently about one-half of REA electric power goes to industries, communities, or non-farm families, according to Budget Director Maurice Stans, and three out of four new users being added to REA co-op lines are now non-farm users. The REA was set up originally in 1935, by an executive order of President Roosevelt, to help provide central-station electric service for people in rural areas who did not have this service available. At that time, only 11% of the nation's farms were connected to central-station power systems. About 95% of the farms today are electrified, due primarily to expansion of electric service facilities by private electric utility companies.

A permanent program for lending money to rural electrical firms was established by Congress in 1936. In that year REA approved loans of nearly $7 million to 29 borrowers. A total of $215 million was approved for electrical co-op loans during 1958.

Through the years since 1936, to date, REA has loaned $3.3 billion to electric co-op systems, and has earmarked $500 million more. Current loans are for financing construction of electric lines carrying electric power supplied primarily by private electric utility firms. In 1958, REA-financed co-ops sold 21.7 billion kwhrs of electric power to nearly 4.6 million customers; about one-half of this power was for industries, and non-farm families.

REA's future money requirements are headed up sharply. Over the next 20 years, REA officials predict, electric co-ops may need $12 billion worth of power lines, substations, generators and office buildings to handle the power load. At that rate, annual loans by REA could total $1 billion by 1978. These co-ops pay no taxes at all, and the Government now foots the bill for its own cost of borrowed money in excess of 2%. In order to correct these inequities, the Administration and Budget Bureau seek to transfer more financial responsibility to the REA co-ops, and Department of Agriculture and REA officials are going along. The co-ops are healthy, going business concerns, these officials maintain, and are now financially able to pay the cost of this money to the Government. But with REA being a politically-sacred subject with most farm-state Congressmen, the Administration may be expected to have difficulty in finding a sponsor for its plan.

A PROPONENT OF apprentice training for motor repair shops, Mason V. Green, manager, motor sales and service, Barker-Fowler Electric Co., Lansing, Mich., helped establish a local 4-year apprenticeship training program. Program is supervised by a joint committee of representatives of cooperating Capital City Electric Motor Shops and IBEW Local 1632. Certificates are issued by Bureau of Apprenticeship, U. S. Dept. of Labor.

Electric Capacity Increased by 10% in '58

Peak electric power load in 1958 for the United States as a whole reached an all-time high of about 113.5 million kilowatts in December, it was announced in a year-end report recently completed by the Electric Power Survey Committee of the Edison Electric Institute, whose study covers more than 98% of the electric utility industry.

The December peak was more than 6%, or about 6½ million kilowatts, higher than the 1957 December peak. It was 4% higher than the 1958 summer peak of about 109 million kilowatts.

To meet the record load, the power industry had an electric generating capability of about 143.7 million kilowatts, the report stated. This was more than 13 million kilowatts higher than the capability at the time of the December, 1957, peak.

"On a percentage basis, the December, 1958, capability is 10% over that of the previous December, while the average annual increase in capability for the past ten years is 10.1%—equivalent to doubling every seven years," the Survey Committee reported.

Gross margin of generating capability over the December, 1958, peak was 26.6% slightly higher than that in December, 1957, and exceeding any corresponding value since World War II.

During 1958, a record power output of 641 billion kilowatthours was achieved, a 2.3% increase over the 1957 production by the electric industry.

Installation of new generating capacity was at a record high during 1958, with more than 14 million kilowatts being added. This exceeded by 12½% the previous record addition of 12.5 million kilowatts in 1955.

About 82% of the new capacity was added by investor-owned electric systems, and 18% by governmental systems—5% by Federal and 13% by non-Federal agencies.

The report lists the kilowatt capability, system and station of each of the 114 thermal and 45 hydraulic units of 4,000 kilowatts and larger added during the year. About 11.7 million kilowatts of the new additions are thermal—more than 83% of the total. Nearly 2.4 million kilowatts are hydraulic—about 17%.

For 1959, approximately 14.4 million kilowatts of new capacity are scheduled to be added. The to-

DIELECTRIC TEST EQUIPMENT *by* BIDDLE

...for d-c tests at voltages up to 100 KV

IMPORTANT FEATURES

- Well-designed provisions for utmost safety
- Simple operation and reliable performance
- Excellent output voltage regulation
- Compact, mobile design
- Facilities for voltage and leakage current measurements

IMPORTANT USES

Development—to test d-c dielectric strength of insulating materials and the adequacy of the electric design of insulation in equipment.

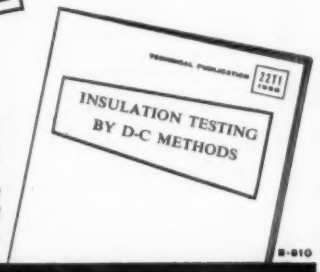
Production—for non-destructively detecting defects in electrical insulation.

Maintenance—and preventive maintenance—for non-destructively detecting unreliable condition of electrical insulation in new or repaired equipment.

NEW TECHNICAL BOOK

A new technical treatise by E. B. Curdts, Director of Engineering, James G. Biddle Co., contains a wealth of pertinent data for the engineer interested in insulation maintenance of electrical equipment.

Copies are available at $2.00 each. Orders should be made on your company's letterhead accompanied by check to the order of the James G. Biddle Co. Ask for Publication 22TIECM.



B-810

JAMES G. BIDDLE CO.

1316 ARCH STREET • PHILADELPHIA 7, PA.

ELECTRICAL TESTING INSTRUMENTS • SPEED MEASURING INSTRUMENTS
LABORATORY & SCIENTIFIC EQUIPMENT

Millions of Steel
JIFFY CLIPS
Serving the Electrical Industry

Specify
MINERALLAC
HANGERS, CLIPS,
STRAPS, BUSHINGS

Expert design, choice materials and controlled manufacture have built "top-service and longest life" into Minerallac Electrical Specialties. That's why the electrical industry "prefers Minerallac"... in steel and Everdur for hanging pipe, conduit, BX cable, etc.

Send for new literature and prices.

MINERALLAC ELECTRIC COMPANY
25 North Peoria Street—Chicago 7, Illinois

MINERALLAC

Control Your
CARBON BRUSH
Inventory with
Handy-Kits and
Cabinets

HELWIG CARBON BRUSHES

Units have lifetime guaranteed See-Thru plastic drawers with moveable dividers. Both Handy-Kit and Cabinets complete with brushes for single phase motors, vacuum cleaners, mixers, fans, portable tools, etc. Units assure you have the right replacement stock on hand.

Write for Bulletin No. 65.

AVAILABLE NOW "RED CARPET" RUSH BRUSH SERVICE.

HELWIG CO.
CARBON
PRODUCTS
2546 N. 30th ST.
MILWAUKEE 10, WIS.

HELWIG SPEER

OVERHEAD COSTS for electrical construction were discussed by James Dandelake (at podium), President of Miller Electric Co., Jacksonville, Fla. before the annual Convention of the Florida Assn. of Electrical Contractors. He was introduced by Vincent Burkhardt (seated), Burkhardt Elec. Co., West Palm Beach, past-President of FAEC, and Chairman of the 1958 FAEC Convention Committee.

tal on order and scheduled for service in 1959 and the next several years amounts to about 39 million kilowatts.

Atomic reactors are scheduled to produce the steam for the initial operation in 1960 of four generating units totaling 737,000 kilowatts, the report states. Two more such units with a combined capacity of 116,000 kilowatts are included in the scheduled additions for 1962.

NEW BOOKS

Closed Circuit Television Systems. 348 pages. Government Service Dept., RCA Service Co., Camden 8, N. J. $4.50.—Fundamentals and techniques of closed-circuit TV; characteristics and typical applications of various types of commercial equipment. To assist in the proper engineering of closed-circuit systems, factors are described which assure reliable performance under various environmental conditions.

Highway Lighting Reference Guide, prepared by and available from the Safe Highway Lighting Commitee of the Street and Highway Safety Lighting Bureau, 1400 Terminal Tower, Cleveland, Ohio. Price: $1.00. Based on the American Standard Practices for Street and Highway Lighting, as developed by the Illuminating Engineering Society for the American Standards Association, it gives for the first time in printed form a complete engineering guide on where and how the nation's highways should be lighted. Designed for use by highway and lighting engineers, as well as all officials charged with the responsibility of providing safe highway lighting, the book first reviews in detail light sources available, including incandescent, mercury and linear fluorescent lamps, and includes appropriate illustrations and tables. A second section is devoted to luminaires, and reviews fundamentals of design, elements used, light distribution, common types in use, quality specifications, standards and tests, installation and maintenance. Lighting equipment supports, power distribution, and series and multiple circuits are also evaluated. Lengthy discussion, with complete position diagrams, is given on intersections and interchanges, connections to service areas, elevated and depressed expressways, tunnels and underpasses, minimum average illumination levels for tunnels, daytime entrance lighting for traffic tunnels, bridges, overpasses and viaducts, highway traffic density sections, curves and hills, railroad grade crossings and urban area approaches. It is expected that the new publication may be instrumental in establishing a uniform approach to the entire problem of highway lighting.

Industrial Electronics Handbook, edited by W. D. Cockrell, General Electric Co. 1408 pages. McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y. $22.50.—Authoritative descriptive and reference material covering all phases of industrial electronics and control, with an emphasis on application and the

DUAL ROLE of superintendent and engineer of the large motor department at Lima Armature Works, Inc., Lima, Ohio, motor service specialists, is handled by Robert Bruce who is equally adept with micrometer or slide rule.

FATHER AND SON team of W. G. Rynes, Sr. (left) and young Bill guide the activities of Rynes Electric Company, enterprising Chicago electrical contracting firm. A recent project: modernization of a Michigan Ave. office building including air conditioning, lighting, elevators and dc to ac changeover.

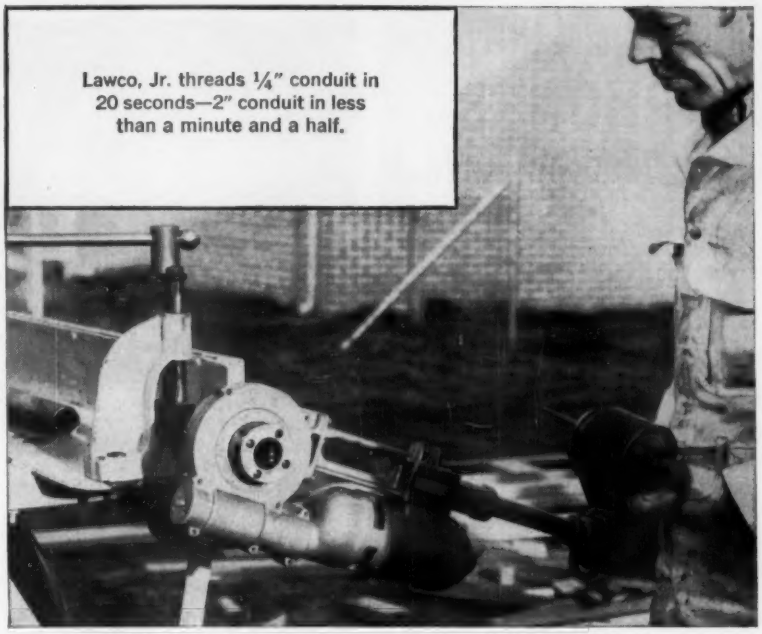
user's needs rather than on design. Nine sections by some 100 contributing experts cover basic engineering and mathematics, control elements, power supplies, control circuits and applications, electronic switches, military application, automation, process control, etc.

Maintenance Hints Handbook. 650 pages, $2.00. Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

Designed to provide quick, complete and convenient guide to modern maintenance practices on all types of electrical equipment. First section covers specific apparatus maintenance; second covers general maintenance of materials used in apparatus, such as insulation. All chapters updated and revised, including new chapter on maintenance of static controls.

Residential and Commercial Air Conditioning, by Charles H. Burkhardt. 300 pages; $9.00. McGraw-Hill Brook Co., Inc., 330 W. 42nd St., New York 36, N. Y.

Planning, installation, and servicing of residential and commercial air conditioners; basic theory of refrigeration and air conditioning; calculating heat gains, sizing the cooling system, installing the unit and its various components, operating the components, and installing and operating controls; includes unique chart method for servicing.



LAWCO JR. PORTABLE PIPE THREADER

threads ¼" to 6" conduit— in seconds—right on the job

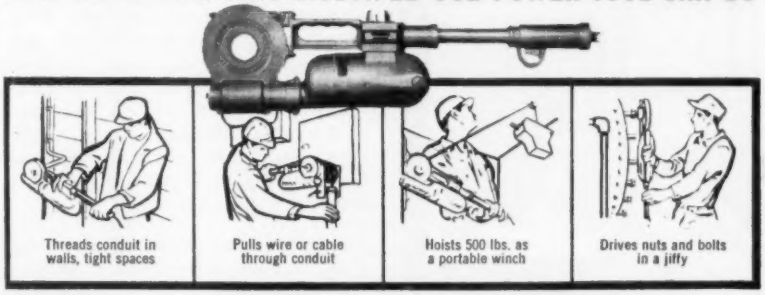
Here's one of the best friends a contractor ever had.

The Lawco, Jr. threads conduit—in a vise, on a wall, in a ditch—just about any place you can take a power cord.

It's lightweight: 20 lbs. Eliminates the need for hauling heavy, bulky, threading machinery to every job. Simply position the Lawco, Jr. on the conduit. Pull the trigger. Then, watch those cutting dies go to work *for* you. It's the safe, handy, economical way to thread.

Handles conduit ¼" through 6". May be used with all makes of threading die stocks by application of appropriate adapters.

LOOK WHAT ELSE THIS MULTIPLE-USE POWER TOOL CAN DO


Threads conduit in walls, tight spaces
Pulls wire or cable through conduit
Hoists 500 lbs. as a portable winch
Drives nuts and bolts in a jiffy

Write for descriptive bulletin

VELOCITY-POWER TOOL COMPANY

201 North Braddock Avenue, Pittsburgh 8, Pennsylvania

INDOOR and OUTDOOR

PHONES

that need no current

Your voice supplies the power needed to operate these Sound Powered Telephone handsets over a distance of many miles. Never fail in an emergency. For temporary or permanent installation.

Write for catalog

HOSE-McCANN

TELEPHONE CO., INC.

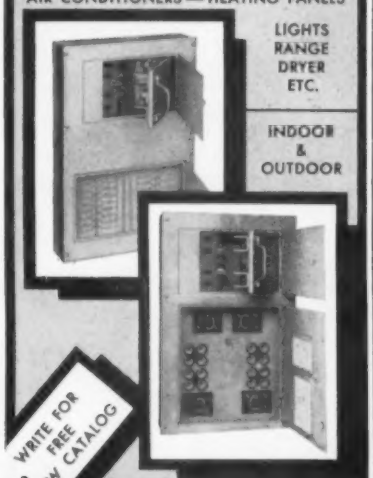
25th St. & 3rd Ave., Brooklyn 32, N.Y.

200 AMPERE

HOUSEPOWER

FUSIBLE OR CIRCUIT BREAKERS

CONTROLS FOR WATER HEATER AIR CONDITIONERS — HEATING PANELS



WRITE FOR FREE NEW CATALOG

The WADSWORTH Electric MFG. CO. INC.

COVINGTON, KENTUCKY.

FOREMAN Joseph V. Alexander of the Althoff Howard Electric Co., Inc. in Evansville, Ind. has been an employee of the firm for many of the 40 plus years they have been doing business from the same location in Evansville.

Legal Aspects of Construction, by Walter C. Sadler. 400 pages; $8.50. McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y.

Rights and liabilities involved in the complex relations of the construction industry; an aid toward avoiding legal entanglements and costly litigation. Traces the pattern of the business of contracting, appraising the potential conflict of interests of contractors, subcontractors, sub-subcontractors, and trade unions.

Engineering Manual: A Practical Reference of Data and Methods in Architectural, Chemical, Civil, Electrical, Mechanical, and Nuclear Engineering, edited by John H. Perry. 680 pages; $9.50. McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y.

A concise reference to the most commonly used data in these engineering fields, covering every major phase of engineering from physical laws involved in the structural design of buildings, to illustrated instructions on highway and traffic engineering—from simple, overall coverage of ac and dc circuits and machines, to recommended practices for meeting today's requirements in the nuclear power fields. Three separate sections present mathematics, mathematical tables, and physical and chemical data.

Electrical Equipment Manual by J. F. McPartland and W. J. Novak. 176 pages. Electrical Wholesaling, Dept. 270-059B, 330 W. 42nd St., N. Y. 36, N. Y. $4.00.—A practical, easy-to-use reference for anyone desiring or requiring a ready background in the fundamentals of elec-

BOOK NEWS-NOTES

NATIONAL ELECTRICAL CODE HANDBOOK

Enables electricians to understand and do work in accordance with the 1956 National Electrical Code. In this handbook you will find explanations of rules and measurements for the various types of jobs —what they mean—how to apply them. Diagrams, sketches, and illustrations used throughout. **By A. L. Abbott. 9th Edition revised by C. L. Smith, Elec. Field Engr., National Fire Protection Assn. 642 pp., 394 illus., $9.00**

ELECTRICAL CONSTRUCTION COST MANUAL

Helps you save time and trouble in estimating electrical construction costs and to develop more realistic, profitable bids. Develops standard assemblies as a nucleus for unit costing of materials and labor; covers job factors, overhead, and profit, and shows how to combine these factors into an integrated cost system. **By Ralph E. Johnson, President, Sturgeon Electric Co. 427 pp., 226 illus., $10.00**

ELECTRICAL MACHINES

Direct and Alternating Current

Just Published—2nd Edition. Explains the theory and practice of virtually all types of electrical machines and accompanying circuits, with special emphasis on their practical applications. Helps you select, install, and operate modern equipment more quickly and efficiently—both d-c and a-c. Covers dynamos, armature windings, generators, polyphase and single-phase motors, and much more. **By Charles S. Siskind, Asst. Prof. of Elec. Engrg., Purdue U. 2nd Edition, 535 pp., 325 illus., $8.00**

HANDBOOK OF INDUSTRIAL LOSS PREVENTION

Just Published. This comprehensive handbook tells how to protect industrial plants and processes against the destructive hazards of fire, explosion, wind, lightning and earthquake. Helps you reduce possibility of widespread damage, cut down insurance premiums for real savings, protect more fully lives and property. **Compiled by the Factory Mutual Engineering Division. 960 pp., 837 illus., $20.00**

10 DAYS' FREE TRIAL

McGraw-Hill Book Co., Dept. EC-2
327 W. 41st St., New York 36, N. Y.

Send me book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep, plus few cents for delivery costs, and return unwanted book(s) postpaid. (We pay delivery costs if you remit with this coupon—same return privilege.)

- ☐ Abbott—**Natl. Elec. Code Hdbk.**, $9.00
- ☐ Johnson—**Elec. Const. Cost Manual**, $10.00
- ☐ Siskind—**Electrical Machines**, 2nd Ed., $8.00
- ☐ Fac. Mut. Engrg. Div.—**Hdbk. of Ind. Loss Prev.**, $20.00

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For price and terms outside U. S. write McGraw-Hill Int'l., N.Y.C. EC-2

trical equipment. Through a format of carefully balanced copy and graphic sketches, the book explains in a simple yet comprehensive manner the basics of today's electrical equipment—from lamps, fixtures, motors and raceways to sound systems, transformers and pole lines.

Engineering Consultants. American Institute of Consulting Engineers, 33 W. 39th St., New York 18, N. Y. $2.50 cloth; $1.50 paper. A directory of qualified engineers and their firms, with some biographical data, as well as information concerning the services in the fields in which they serve. Also included is a classified index for convenience in locating engineers for particular types of problems.

Construction Accounting and Financial Management, by William E. Coombs. 490 pages; $12.85. F. W. Dodge Corp., 119 W. 40th St., New York 18, N. Y.

Proper accounting and management procedures; what records to keep, and why. Relation of accounting and record keeping to the size of the firm and type of work being done. Topics include prejob procedures, purchasing and subcontracting policies and procedures, change order routines, accounting for labor, materials, supplies and equipment, subcontract costs and overhead, plus 200 checklists, illustrations, and sample forms and reports. Useful to contractors, architects, engineers, and management.

PROPONENT of electric home heating is E. J. Cizek, treasurer, Wm. Koch Co., Inc., La Grange, Ill., electrical contractors. After expanding into this field, the Koch firm is convinced it offers profitable "plus" business for the contractor.

REPAIR FOR YOUR B&D TOOLS

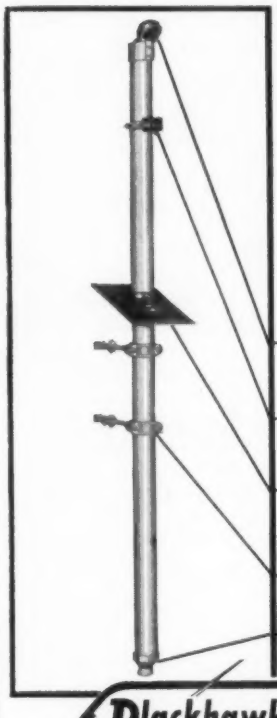
For genuine Black & Decker repairs check Yellow Pages under "Tools-Electric" for address of nearby Black & Decker

FACTORY SERVICE BRANCH

Free tool inspection when requested • Genuine B&D parts used • Factory-trained technicians handle all work • Standard B&D Guarantee at completion of recommended repairs • Fast service at reasonable cost.

Or write for address of nearest of 48 branches to:
THE BLACK & DECKER MFG. CO., *Dept. S3102, Towson 4, Md.*

Black & Decker®
QUALITY ELECTRIC TOOLS



INSTALLED FAST BUILT TO LAST

Blackhawk Service Entrance Mast Kits better from top to bottom

5 GOOD REASONS *why a Blackhawk kit means a faster, better installation from cable entrance to meter. May be purchased as a complete kit or as separate fittings.*

1. **Slip-fitter service entrance head** — Just slip it on over conduit and tighten two set screws. That's all. Made of corrosion-resistant aluminum. Available in a full range of sizes. (Patent applied for.)
2. **Insulators** — Reinforced, durable, well-rounded porcelain secured to metal pipe mounting clamp, galvanized.
3. **Flexible Synroflashing** — Made of flexible neoprene to absorb vibration. Mast can't work loose, damage shingles, or cause leaks. Won't rot, peel or crack in any weather. Available for 1¼, 1½, 2 and 2½" pipe.
4. **Mounting brackets** — Exposed parts corrosion-resistant aluminum alloy. Shoulder eye fits flat. Lock set screw gives additional grip. Meets installation requirements.
5. **Offset reducer** — Corrosion-resistant aluminum alloy. Fits 1¼" and 1½" hubs to a 2" or 2½" pipe riser.

The better-made parts in a Blackhawk kit let you do a fast and sound job on every service entrance mast installation. Saves you time, builds your reputation for quality and service.

Specify B-I when you buy!

Blackhawk Industries
DUBUQUE, IOWA *where the new ideas come from*

Guard Against
injury
loss of life
confusion
SUDDEN BLACKOUTS
destruction
panic

be prepared with

Big Beam
AUTOMATIC EMERGENCY LIGHTS

Storage Battery Always Fully Charged—Built-in Charger

Just plug in a BIG BEAM Emergency Light and rest assured that when regular lights fail, your plant or building will be protected automatically with hours of bright, SAFE illumination. Variety of models available.

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Wire and Cable Trade Names. National Electrical Manufacturers Assn., 155 E. 44th St., New York 17, N. Y. $0.50.—A compilation of trade names and trade marks of bare and insulated wire and cable and insulating materials used in the electric power field.

Lighting the Stage, 157 pages, by P. Corry, Pitman Publishing Corp., 2 West 45th Street, New York 36, N. Y. Price: $6.00. This second edition, dated 1958, presents a simple explanation of the use of light as an active part of theatrical production, in terms of direction, intensity, and color. It explains the importance of light, defines what must be lighted, and relates the lighting effects that may be selected by the producer to borders and ceilings, curtain settings and scenery settings. It also discusses stage lighting and control equipment, color in light, cyclorama, trick and special lighting effects, scenery, lighting and dress rehearsals, performances, the platform stage, etc. While the light sources, stage lighting equipments, dimmer control systems, etc. listed in this book of English origin are not comparable to modern American equipments, the author's treatment of stage lighting principles provides a sound basis for thorough analysis of stage lighting problems which should be invaluable to consulting electrical engineers and others engaged in the design of stage lighting.

DATES AHEAD

National Electrical Week — An all-industry event, February 8-14.

National Rural Electric Co-op Assn.— National Guard Armory, Washington, D. C., February 9-12.

Electric Associates, Inc. — National Electrical Week luncheon, Sheraton-Astor Hotel, New York, N. Y., February 10.

2nd Biennial Electrical Trade Conference & Exposition — Sponsored by Electrical Trade Institute of Washington, Sheraton Park Hotel, Washington, D. C., February 17-18.

Upper Midwest Electrical Industry Convention — Leamington Hotel, Minneapolis, Minn., February 22-25.

15th Annual National Wiring Sales Conference—Jung Hotel, New Orleans, La., February 26-27.

Electrical Estimating Institute—Conducted by the University of Wisconsin in cooperation with the College of Engineering, Madison, Wis., Feb. 26-27.

2nd National Lighting Exposition—Coliseum, New York, March 1-4.

Industrial Electrical Exposition—Sponsored by Essex Electrical League, National Guard Armory, Elizabeth, N. J., March 10-12.

International Association of Electrical Inspectors — Virginia Chapter, Charter House Hotel, Fairfax, Va., March 30-31; **Ellis Cannaday Chapter of North Carolina,** Carolina Hotel, Raleigh, N. C., April 7-8; **Georgia-South Carolina Chapters,** Joint meeting, Richmond Hotel, Augusta, Ga., April 12-14; **Alabama Chapter,** Jefferson Davis Hotel, Montgomery, Ala., April 16-17; **Florida Chapter,** Sarasota Terrace Hotel, Sarasota, Fla., May 8-9; **Baton Rouge, George Welman, North Louisiana-East Texas, Texas, Texas Gulf Coast Chapters,** Five chapter joint meeting, Carlton Hotel, Tyler, Texas, May 15-16; **Northwestern section,** Seattle Hotel, Seattle, Wash., August 24-26; **Canadian Section,** Montreal, Quebec, Canada, September 25-26; **Western Section,** Schroeder Hotel, Milwaukee, Wis., October 5-7; **Southern Section,** Heidelberg Hotel, Jackson, Miss., October 12-14; **Mississippi Chapter,** Heidelberg Hotel, Jackson, Miss., October 12-14.

Illuminating Engineering Society—Regional Conferences; **East Central,** Lord Baltimore Hotel, Baltimore, Md., April 8-9; **Southeastern and South Central,** Grove Park Inn, Asheville, N. C., April 23-24; **Southwestern,** Shamrock-Hilton Hotel, Houston, Texas, May 4-5; **Midwestern,** Pere Marquette Hotel, Peoria, Ill., May 6-8; **Inter-Mountain,** Continental Hotel, Denver, Colo., May 11-12; **Pacific Northwest,** Buffalo Springs Hotel, Bariff, Alta., (Canada), May 26-30; **Northeastern,** Curtis Hotel, Lenox, Mass., June 4-5; **Canadian,** Chateari Laurier, Ottawa, Ont., (Canada), June 11-12; **Great Lakes,** Statler Hotel, Buffalo, N. Y., June 22-23.

American Power Conference — Sponsored by Illinois Institute of Technology in cooperation with some 14 colleges and technical societies, Hotel Sherman, Chicago, March 31 and April 1-2.

Edison Electric Institute—Annual Convention, New Orleans, La., April 5-9.

Progress in Electrical Equipment—Kiel Auditorium, St. Louis, Mo., April 7-9.

National Association of Lighting Maintenance Contractors—Annual conference, Cosmopolitan Hotel, Denver, Colo., April 27-29.

National Industrial Service Assn. — Queen Elizabeth Hotel, Montreal, Canada, May 17-21.

Building Research Institute—Building Illumination Conference, Statler-Hilton Hotel, Cleveland, Ohio, May 20-21.

Pacific Coast Electrical Association, Inc.—Annual convention, Fairmount Hotel, San Francisco, Calif., May 20-22.

National Association of Electrical Distributors—51st annual convention, Conrad Hilton Hotel, Chicago, Ill., May 24-29.

National Fire Protection Assn.—Annual meeting, Atlantic City, N. J., May 25-29.

New York State Association of Electrical Contractors and Dealers — 60th Annual convention, Whiteface Inn, Lake Placid, N. Y., July 7-10.

Western Electronic Show & Convention—Cow Palace, San Francisco, Calif., August 18-21.

Illuminating Engineering Society—National Technical Conference, Fairmont Hotel and Mark Hopkins, San Francisco, Calif., September 7-11.

Canadian Electrical Manufacturers Assn.—15th annual meeting, Sheraton-Brock Hotel, Niagara Falls, Ont., Canada, September 30, October 2.

11th Biennial Electrical Industrial Exposition—Sponsored by Essex Electrical League; Armory, Elizabeth, N. J., October 10-12.

National Electronics Conference — Sherman Hotel, Chicago, Ill., October 12-14.

Electrical Progress Show—Sponsored by Electrical Association of Philadelphia, Convention Hall, Philadelphia, Pa., October 13-15.

National Electrical Contractors Association—Annual convention and 5th National Electrical Exposition, Fontainebleau, Eden Rock, Deauville and Carillon Hotels, Miami Beach, Fla., November 9-12.

National Electrical Manufacturers Assn.—Annual meeting, Traymore Hotel, Atlantic City, N. J., November 9-13.

Industrial Electric Exposition—Sponsored by Electrical League of Western Pennsylvania, Penn-Sheraton Hotel, Pittsburgh, Pa., November 17-19.

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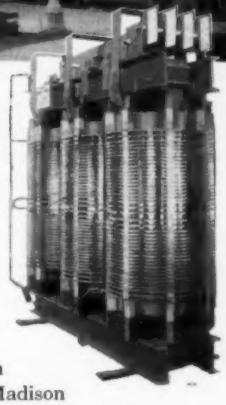

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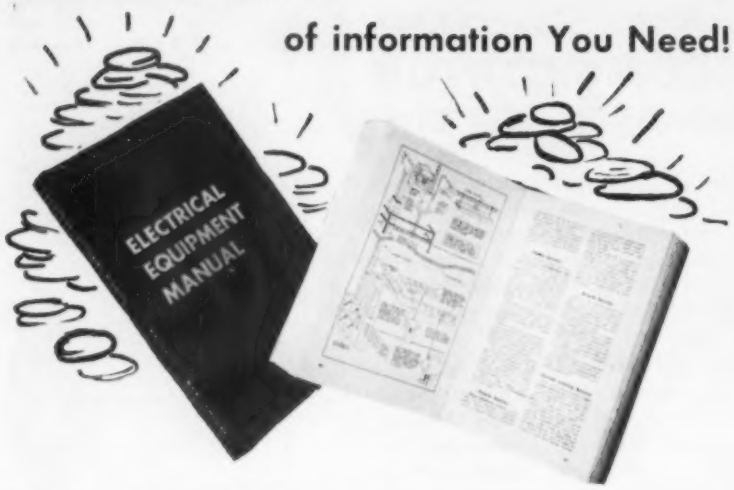

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Among the Manufacturers

Headquarters Announcements

Rome Cable Corp. and **Aluminum Co. of America** have announced plans to affiliate in March. Electrical conductors, conduit and accessories facilities will be combined in new company called **Rome Cable Co.**

Benjamin Electric Mfg. Co., Des Plaines, Ill., has been purchased by **Thomas Industries Inc.,** Louisville, Ky., and will be operated as a division.

Kennecott Wire and Cable Co. has become an operating division of **The Okonite Co.,** Passaic, N. J.

Westinghouse Electric Corp., Pittsburgh, Pa., has purchased the **S. Heller Elevator Co.** of Milwaukee, Wis.

Thermoid Div., H. K. Porter, Inc., has been formed of **Forter's Quaker Rubber Div. and the Thermoid Co.,** and will manufacture all products formerly made by Quaker Rubber.

Toledo Pipe Threading Machine Co., Toledo, Ohio—Norman J. Kirk, president and general manager.

Line Material Industries, Milwaukee, Wis.—R. C. Kirk, vice president, research and engineering.

Crouse-Hinds Co., Syracuse, N. Y.—George B. Jamison, divisional manager of Gulf Div., Houston, Tex.

Struthers-Dunn, Inc., Pitman, N. J.—John L. Pfeffer, president.

Rockbestos Products Corp., New Haven, Conn.—Alexander S. Basil, vice president in charge of manufacturing.

Robertson Electric Co., Buffalo, N. Y.—Knud B. Muenter, manager, Switchgear and Box Div.

Royal Electric Corp., Pawtucket, R. I.—Jules P. Goldsmith, vice president, marketing.

Day-Brite Lighting, Inc., St. Louis, Mo.—George J. Taylor, vice president and director of research; Charles L. Amick, executive director of new Research Dept.; Gordon Wells, general manager of sales.

Sargent Electric Corp., Lynbrook, N. Y.—George A. Treiber, general sales manager.

Steelduct Co., Youngstown, Ohio —William F. Zarbaugh, vice president, sales.

Sylvania Electric Products Inc., New York—Robert E. Lewis, president.

Howard Electric Co., Detroit, Mich.—Eugene C. Howard, vice president and secretary, plus added duties of general manager.

Minnesota Mining & Mfg. Co., St. Paul, Minn.—Dr. Carl E. Barnes, vice president for research.

All-Brite Fluorescent Fixtures, Inc., South San Francisco, Calif.—E. O. Anders, chairman of the board.

Carlon Products Corp., Aurora, Ohio—A. Thomas Campbell, sales manager, Electrical Products Div.

Edwards Co., Inc., Norwalk, Conn.—Robert L. Kempton, director of marketing.

General Electric Co., Schenectady, N. Y.—Raymond W. Smith and Harold A. Strickland, Jr., vice presidents.

Robertshaw-Fulton Controls Co., Indiana, Pa.—Henry F. Hild, general manager of new Indiana Div., specializing in electrical controls.

Electric Storage Battery Co., Philadelphia, Pa.—Thomas E. Peacock, marketing manager, Exide Industrial Div.

Thomas Industries Inc., Louisville, Ky.—Thomas Fuller, vice president.

Westinghouse Electric Corp., Pittsburgh, Pa.—Howard S. Kaltenborn, vice president and assistant to president; Dr. S. W. Herwald, vice president in charge of research.

Youngstown Sheet and Tube Co., Youngstown, Ohio—Richard J. Stamberger, manager of new Trade Relations Dept.; Robert W. Walling, manager of High Strength Sales; Roy A. Curl, manager of sales promotion and advertising.

Square D Co., Detroit, Mich.—Mitchell P. Kartalia, vice president.

Bryant Electric Co., Bridgeport, Conn.—W. B. Rankin, manager, wiring device sales.

Regional Appointments

MIDDLE ATLANTIC

International Rectifier Corp.: Arno Nash, regional sales manager, Eastern Div.

Freed Transformer Co., Inc.: Martin P. Andrews, Inc., repre-

Cutler-Hammer, Inc.: J. P. Simon, eastern regional sales manager; S. S. Blackmore, Philadelphia district manager; O. P. Proudfoot, central regional sales manager; R. D. Burd, Buffalo district manager.

Electrosnap Corp.: Kacil Brin, manager of New York office in Beth Page, N. Y.

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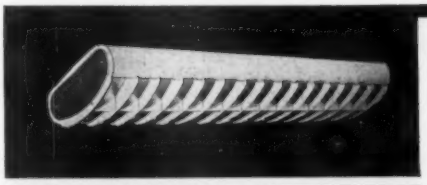

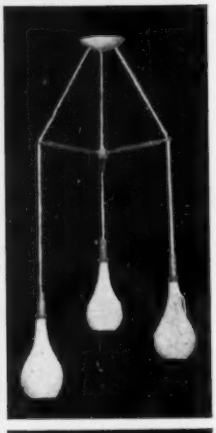

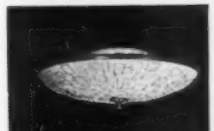

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Wolverine Tube: Philip Mackay, sales manager, Philadelphia district.

SOUTH ATLANTIC

Cutler-Hammer Inc.: R. A. Blue, Baltimore branch manager; W. M. Reese, Newark branch manager.

Electro Compound Co.: Hopper & Associates, Miami, representatives in Florida; Joseph B. Babb, Birmingham, representative in Alabama, Tennessee and northwestern Florida.

I-T-E Circuit Breaker Co.: John W. Harrawood, district manager, new Charlotte, N. C., office.

Edwards Co.: William L. Pierce, southern regional manager.

Allis-Chalmers Industry Group: S. B. Lamica, manager, Jacksonville, Fla., district.

Killark Electric Mfg. Co.: Eastern Sales Co., representative in Maryland and Washington, D. C. areas.

EAST CENTRAL

Wolverine Tube: Richard B. Flynn, sales manager, Cleveland district; Carl T. Fuller, sales manager, Chicago district; Edmund J. Campbell, sales manager, Detroit district; Richard C. Cash, sales manager, Birmingham district.

Cutler-Hammer Inc.: J .H. Sauer, Indianapolis district manager; C. A. Russ, Minneapolis district manager; E. E. Durham, Cleveland district manager; E. A. Clark, southern regional sales manager; R. A. Haworth, midwestern regional sales manager; R. L. Hibbard, Chicago district manager.

Youngstown Sheet and Tube Co.: Frank A. Anderson, St. Louis district manager.

Tork Time Controls, Inc.: Robert L. Kanter, representative in Chicago and northern Illinois.

Quadrangle Mfg. Co.: Roy L. Clinton, representative in western half of Pennsylvania and northern half of West Virgina.

Minnesota Mining & Mfg. Co.: R. E. Strawbridge, insulation sales manager in Cleveland-Detroit-Pittsburgh-Grand Rapids areas.

International Rectifier Corp.: Alex Blumenberg, district manager, Michigan area.

Hoffman Engineering Corp.: Kenneth G. Anderson, representative in northern Illinois and southern Wisconsin.

General Electric Co.: S. D. Hopper, consultant, field sales, Cleveland; R. C. Schey, district manager, Great Lakes office—Construction Materials Div.

ELECTRIC HEATERS for space heating were discussed by Jim Igon (left), of Cavalier Corp., Orlando, Fla. and Bert Lenhart, Lenhart-Payne Electric Co., Leesburg, Fla., during recent Convention and Electric Trade Show of Florida Assn. of Electrical Contractors.

WEST CENTRAL

Quadrangle Mfg. Co.: R. E. Madigan Co., representative for state of Wisconsin and upper peninsula of Michigan.

Cutler-Hammer Inc.: W. J. Phillips, Dallas district manager.

Wolverine Tube: George W. Overstreet, sales manager, Dallas district; T. F. Vigmostad, sales manager, St. Louis district.

J. A. Weaver Co.: J. P. Tendirck &Associates, representatives in state of Wisconsin.

Rawlplug Co.: Jack Grattan, manager, Rawlplug Dallas Co.

Sequoia Wire and Cable Co.: Frank J. Babka, Midwest manager, office in St. Louis.

WEST

J. A. Weaver Co.: George E. Metcalf Co., Denver, representative in Colorado, Wyoming and Montana.

Cutler-Hammer Inc.: R. C. Seibert, western regional sales manager; W. H. Palin, Los Angeles district manager.

General Electric Co.: J. H. Alderman, northwestern district manager, Construction Materials Div.

I-T-E Circuit Breaker Co.: John J. O'Ryan, manager, Denver district office.

Feedrail Corp.: T. J. Vieau and Associates, representative in Colorado, Wyoming and New Mexico.

Kaiser Aluminum & Chemical Sales: L. M. Guibara, western region insulated products manager; R. R. Piantanida, western electrical conductor regional manager—Electrical Conductor Div.

Electro Compound Co.: Matzinger-Johnson Co., representative in southern California, Nevada and Arizona.

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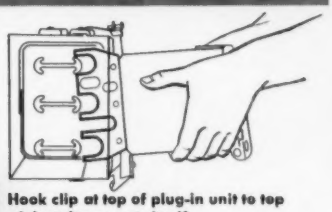
• These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE

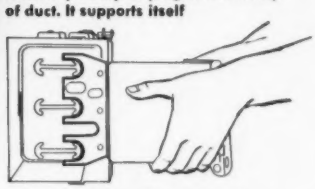
Another Reason for Using Square D Aluminum Plug-in Duct...

SQUARE D PLUG-IN UNITS GIVE YOU EXCLUSIVE *hook-swing* MOUNTING

Safer, Faster, Easier Mounting



Hook clip at top of plug-in unit to top of duct. It supports itself



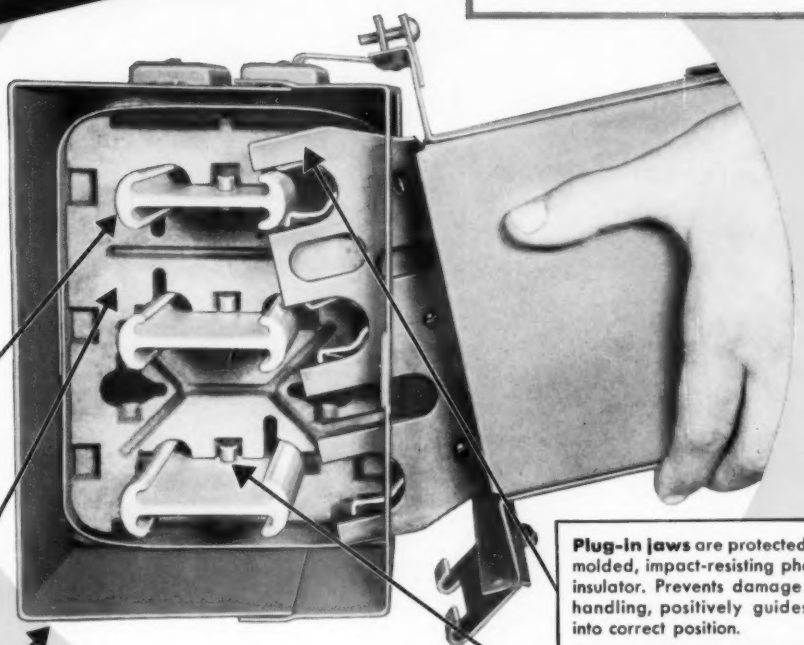
Then, just swing plug-in unit down until jaws engage bus bars

Hanger mounting (*not shown*) makes installation easy. A universal hanger permits mounting in *any* position. Just suspend and level top portion of hanger, then clip on lower portion. U.L. approved for 10-foot spacing.

I-beam construction of bus bars—a Square D exclusive—provides four times the strength of conventional bus bars. Bars are zinc, copper and silver-plated full length.

Full width bus support provides greater strength on short circuits, freedom from vibration. Also acts as fire stop where duct passes through walls and floors.

Square D duct is totally enclosed for maximum safety—no danger of accidental shorts. Prevents overheating from dust accumulation.



Plug-in jaws are protected by a molded, impact-resisting phenolic insulator. Prevents damage from handling, positively guides unit into correct position.

Steel pins in each bus bar prevent bars from shifting and support them on vertical riser installations.

With other plug-in duct, it's no easy job to mount the plug-in units. In fact, it takes a lot of real pushing which is neither safe nor easy when you're working on a ladder. With Square D's exclusive *hook-swing* mounting, you just hook the plug-in unit to the top of the duct. Then, simply swing it down and in until the jaws have engaged the bus bars. No awkward pushing required—no unnecessary chances to take.

Square D aluminum plug-in duct with exclusive *hook-swing* mounting costs no more—why settle for less?

Write for Bulletin SD-110. It gives the facts on Square D aluminum plug-in duct. Address Square D Company, 6060 Rivard Street, Dept. SA, Detroit 11, Michigan

EC&M HEAVY INDUSTRY ELECTRICAL EQUIPMENT...NOW A PART OF THE SQUARE D LINE

SQUARE D COMPANY

New CROUSE-HINDS EXPLOSION-PROOF MERCURY VAPOR LIGHTING FIXTURES

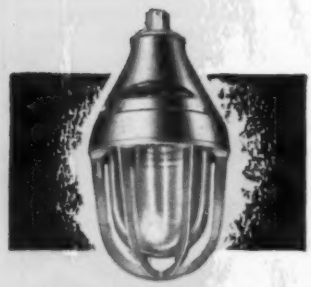
For dependable security at low operating cost in hazardous locations . . .

- *where long burning hours without interruption are involved, month in, month out*
- *where labor cost or trouble of relamping is an important factor*
- *where maximum lighting output calls for maximum economy in power consumption*

The longer life of mercury vapor lamps is well established: 7000 hours, *vs.* 1000 hours for incandescents. Light output is 2.5 times greater; 55 lumens/watt, *vs.* 22 lumens/watt for incandescents.

The new EV's place these economies within easy reach. As with all Crouse-Hinds explosion-proof devices, EV's are heavily constructed to withstand the pressure of internal explosions without rupturing. Gas-tightness is *not* a requirement for their safe performance. Flame-tight joints prevent the escape of flames to flammable atmospheres.

- *For full information, call your Crouse-Hinds distributor, or write for catalog sheet.*



TYPE EVA Explosion-Proof Lighting Fixture

Available with or without guard, or reflector (dome, deep bowl, shallow bowl, angle, or high bay)

250 Watt— National Electrical Code: Class I, Groups C & D

400 Watt— Class I, Group D

CROUSE HINDS

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